SCIENCE

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WILLIAM HARKNESS.

PROFESSOR WILLIAM HARKNESS, U.S.N., whose name has been identified with the work of the United States Naval Observatory for nearly forty years, died in Jersey City, N. J., February 28, 1903.

On his retirement for age from active service in December, 1899, he went to his home with the intention of returning to Washington, after a short rest, for the purpose of devoting his well-earned leisure to scientific work which the press of official duties had prevented him from completing. An attack of nervous prostration obliged him to defer returning to Washington until he should recover sufficient strength. Month by month he expressed his expectation soon to be strong enough to return, but he never recuperated sufficiently to carry out his cherished plans. Weakness of body confined him quite closely to the house, so much so that he dared to venture on the street not more than half a dozen

times during the last three years. The immediate cause of his death was Bright's disease, which fastened itself upon him during the last few months of his life.

The following biographical memorandum prepared by Professor Harkness' own hand gives an accurate statement in a condensed form of the facts of his education and his career. This statement is all the more interesting because the writer indicates clearly the discoveries and achievements which he deemed notable and important.

A. N. Skinner.

BIOGRAPHICAL MEMORANDUM.

Harkness (William), son of Rev. Dr. James and Jane (Weild) Harkness, born at Ecclefechan, Scotland, December 17, 1837; height, 5 feet 10.0 inches; average weight, 185 pounds; circumference of head, 23.0 inches; cephalic index, 0.733. Entered Lafayette College, Easton, Pa., in 1854, but owing to the removal of his parents to Rochester, N. Y., became a student in Rochester University in 1856, and graduated with the degree of A.B. in 1858. From Rochester he also received the degree of A.M. in 1861, and LL.D. in 1874. From Lafayette he received the honorary degree of A.M. in 1865. Studied medicine in New York, and received the degree of M.D in 1862. Was reporter in the New York Legislature for the Albany *Atlas and Argus* in 1858, and in the Pennsylvania Senate for the Harrisburg *Daily Telegraph* in 1860. Appointed from New York as aid at the United States Naval Observatory August 1, 1862. Served as surgeon at the second battle of Bull Bun, August 30, 1862. Commissioned professor of mathematics in the Navy with the relative rank of lieutenant-commander, August 24, 1863, and served at the Naval Observatory until October 4, 1865. Served with the Army during Early's attack on Washington, July 11–12, 1864. Served on the United States monitor *Monadnock* from October 17, 1865, to June 28, 1866, making exhaustive observations on the behavior of her compasses under the influence of the heavy iron armor of the ship, and also completely determining the terrestrial magnetic declination, inclination and horizontal force at all the principal ports visited during the cruise, which extended from Philadelphia to San Francisco, *viâ* the Straits of Magellan and the western passages on the coast of Patagonia. This was the most elaborate discussion of the behavior of compasses on armored ships which had been made up to that time, and all the magnetic work of the cruise was published by the Smithsonian Institution in 1871, forming a large quarto volume of 225 pages. During this cruise the *Monadnock* was present at the bombardment of Valparaiso by the Spanish fleet, March 31, 1866, and also at the bombardment of Callao by the same fleet on May 2, 1866. From San Francisco Professor Harkness traveled across the continent to Omaha, partly by military transportation and partly by stage-coach, the Pacific railroad not having been built at that time. Upon returning to Washington he was attached to the Hydrographic Office from October 14, 1866, until October 1, 1867, and to the Naval Observatory from October 1, 1867, until May 30, 1874. Observed the total solar eclipse of August 7, 1869, at Des Moines, Iowa, and there discovered the now famous coronal line *K* 1474. Observed the total solar eclipse of December 22, 1870, at Syracuse, Sicily, and before returning to the United States visited nearly all the principal European observatories, including Greenwich and Pulkowa. November 13, 1871, was appointed one of the original members of the United States Transit of Venus Commission, to arrange for observing the transits of Venus in 1874 and 1882.

Took part in all the deliberations of the commission, devising most of the instruments used by the observing parties, and was actively engaged for more than two years in fitting out the various United States expeditions. Attained the relative rank of commander May 31, 1872. Was attached to the United States steamer *Swatara* from June 3, 1874, to June 3, 1875, during her voyage to the southern hemisphere with the United States transit of Venus parties, and visited all the points at which she touched. His own station was at Hobart, Tasmania, and after successfully observing the transit of Venus there on December 9, 1874, he accompanied the *Swatara* to the German transit of Venus station on Auckland Island, in latitude 50° 56′ S., and to the United States station on Chatham Island, and finally left her at Melbourne, returning to Washington *viâ* the Hawaiian Islands and San Francisco, thus making a complete tour around the world. On June 22, 1875, was assigned to special duty at the Naval Observatory in connection with the reduction of the observations made by the United States transit of Venus parties. The records obtained by them consisted principally of wet collodion photographs upon glass plates, showing an image of the sun about four inches in diameter, with Venus upon it, and the problem before Professor Harkness was to devise instruments and methods for measuring these photographs which would give the relative positions of Venus and the sun with the utmost accuracy. This he accomplished in an entirely satisfactory manner, although the difficulty of the problem was so great that the most eminent astronomers of England and Germany failed to obtain any useful results from the photographs taken by their parties. While engaged upon the transit of Venus reductions, in 1877, he invented the spherometer caliper, which is probably the most accurate instrument known for determining the figure of the pivots of astronomical instruments, and in 1879 he discovered the theory of the focal curve of achromatic telescopes, which is now universally used for exactly defining their color corrections. In April and May, 1876, he set up the government astronomical exhibit at the Centennial Exposition in Philadelphia, Pa. Attained the relative rank of captain April 17, 1878. Observed the transit of Mercury of May 6, 1878, at Austin, Texas, and the total solar eclipse of July 29, 1878, at Creston, Wyoming, having charge of the United States Government parties at these places, and subsequently edited the quarto volume of 430 pages containing the reports on the eclipse, which was issued by the Naval Observatory in 1880. Immediately thereafter he took up the photographic observations of the transit of Mercury, and they were reduced under his supervision in 1880 and 1881. At the same time he also carried out some rather extensive experiments in astronomical photography, including the spectra of the sun and moon, with the view of ascertaining the most suitable kind of pyroxyline, and the best form of apparatus for photographing the corona during total solar eclipses. In 1881 to 1883 he was engaged in reducing the zones of stars observed by the late Captain James M. Gilliss, at Santiago, Chile, during the years 1849–52; but that work was suspended for want of funds on June 30, 1883, and was not completed and published until 1895. On account of the failure of the English and German astronomers to obtain any satisfactory results from their photographs of the transit of Venus of December, 1874, they decided not to employ photography in observing the transit of December, 1882, and a very prominent American astronomer urged the United States Transit of

Venus Commission to pursue the same course. To combat that idea, Professor Harkness published an elaborate paper 'On the Relative Accuracy of Different Methods of Determining the Solar Parallax,' which was immediately translated and reprinted in France, with the result that both the United States and France decided to continue the use of photography. In 1882, as the principal executive officer of the United States Transit of Venus Commission, Professor Harkness fitted out all the United States Government parties for observing the transit which occurred on December 6, of that year, and observed it himself at a station established on the grounds of the Naval Observatory, Washington, D. C. The work of reducing all the observations obtained by the various parties was assigned to him, and with the aid of a small corps of assistants he completed it in a little more than six years, the final result for the value of the solar parallax from the photographs being obtained on February 13, 1889. During the years 1889 and 1890 he devoted much time to the preparation of his work on 'The Solar Parallax and Its Related Constants,' which was published in 1891, and from that date until December, 1899, he was principally occupied with matters relating to the building of the new Naval Observatory, in devising and mounting its instruments and apparatus, and in establishing a proper system of routine observing. In 1891 he drew up the specifications for the construction of the 12-inch equatorial telescope, and for the repairing and remounting of the 26-inch equatorial telescope, the 8.5-inch transit circle, the meridian transit instrument and the prime vertical transit instrument. In 1894 he prepared detailed specifications for the construction of the 6-inch steel transit circle, and in 1895–96 he arranged all the details for the construction of the 5-inch steel alt-azimuth instrument. All these instruments are now mounted in the new Naval Observatory, and their principal parts are proportioned in accordance with general formulæ which Professor Harkness deduced from an examination of the drawings and specifications of nearly all the large instruments which have hitherto been constructed for the great observatories of the world. Among the novelties introduced in these instruments by Professor Harkness may be mentioned the dials which face the observer when using the quick motions of the equatorial telescopes, and constantly indicate the exact right ascension and declination of the points in the heavens to which these telescopes are directed, and the construction of the 6-inch transit circle and the 5-inch alt-azimuth instrument entirely of steel, including the telescope tubes and their axes, which are machined both inside and out, so as to reduce flexure to a minimum. On October 21, 1892, Professor Harkness was appointed chief astronomical assistant to the Superintendent of the Naval Observatory, and on September 21, 1894, he was appointed Astronomical Director of the Naval Observatory, with complete control of all its astronomical work. In addition to the astronomical directorship, he was appointed Director of the Nautical Almanac on June 30, 1897, and both of these offices he held until his detachment from all duty on December 15, 1899, preliminary to his retirement for age on December 17, 1899, when he was promoted to the rank of rear-admiral.

Professor Harkness has published many scientific papers, and is a member of numerous scientific societies. He was president of the Washington Philosophical Society in 1887, vice-president of the American Association for the Advancement of Science in 1881 and 1885, and its president in 1893.

APPLIED ECOLOGY.

ECOLOGY as a special branch of botanical study has been segregated from the broader field only in recent times, the name having been first suggested by Häckel some twenty-five years ago. But like many phases of human knowledge, practically the study of ecology, that is, of the adaptation of plants to their surroundings, has occupied man these hundreds of years. Long before the study of ecology assumed the dignity of a science did practitioners not only study but apply their knowledge for practical purposes in the production of plants. Agriculture and, still more so, silviculture are based upon the recognition of the ecological relations of plants.

The agriculturist goes so far as to create the ὄικος, the environment, and hence needs less knowledge of adaptation. He can create an environment desirable to any plant. But the silviculturist has not the opportunity to the same extent to fit the environment to his crop; he must study the fitting of his crop to the environment, and as his crop is required to persist for a century or so, adapted to both the stable and variable conditions of the environment, the adaptations must be studied with great care, so that the changes in environment may not prove detrimental to his crop. There are many botanists, even those devoted to ecological studies, who have not given thought to all the factors of importance in the environment which need consideration with a plant of such long duration as a tree. That trees are plants, unique in character and differently situated, as regards ecological factors, from the low vegetation, has hardly been realized.

It is in the hope of stimulating development in this direction and to enlist botanists to aid the practitioners that I venture to point out the directions in which more light is desired by the silviculturist.

Besides the general laws of ecology, which establish principles of adaptation, and which have been so satisfactorily elucidated by Schimper, Warming and others, the practitioner is especially interested in definite knowledge regarding particular species in their adaptations to particular conditions; he needs knowledge of the 'silvicultural requirements' of species, which is and has been for a hundred years his term for ecology.

There are stable or practically unchangeable factors, and unstable or variable factors of environment, with which the silviculturist has to deal.

To the stable factors he must find the crop adapted; the variable factors he can to a certain extent control and shape so as to secure satisfactory results.

The stable factors of environment are soil and general or local climate; the unstable are seasonal variations and certain climatic conditions, plant and animal associates, and light.

As regards soil, it is first of all to be considered that chemical constitution plays probably only a small part or practically none; the reliance of tree growth on mineral constituents being relatively small.

For European species a long series of analyses has shown a great variability of ash contents according to the soil on which the tree has grown, proving that a large part of these contents may be simply fortuitous and not essential to the growth. Moreover, the total amount of mineral constituents in a tree is not only very small, but by far the largest portion is found in the leaves and young parts, suggesting again their merely fortuitous presence as a residue of the transpiration current, and mostly not required. For our own species, I am not aware that any extended investigation has been made in this respect.

The physical conditions of the soil, especially with reference to water conduc-

tivity and water storage capacity, are the more important of the edaphic factors.

The most important of the adaptations to be studied here are those of the root systems, gross as well as minute.

We recognize three types, with many gradations between them—the tap-root, the heart-root and the tracing root system. It is evident that the last, shallow-rooted, system is best adapted mechanically to the shallow soils, but since it must supply itself from the surface, its chances of securing sufficient supplies are limited, hence these species are, relatively speaking, not adapted to dry soils or dry atmospheres. On the other hand, the deep-rooting species can secure water from great distances below ground. They would be naturally what the ecologist calls xerophil in their nature. This term is badly chosen, just as the term hydrophil, for the agriculturist, as well as the horticulturist and silviculturist, has amply proved that most plants love neither dry nor wet conditions, although some are more capable of enduring such extreme conditions.

The trees of the swamps, or many of them, are good examples of this adaptability, for they are also often found to occupy the driest soils. They would appear xerophil and hydrophil at the same time, but as a matter of fact they love neither and would thrive much better in such conditions as the farmer or the nurseryman prepares for his crop; it is only in the competition with other, better-adapted forms, that the unfavorable sites are left to them, to which they are still able to adapt themselves.

Some of the deep-rooters have the capacity of modifying their root system and adapting it to shallow soils. Concerning this practically so important phase of ecology we have little or no knowledge as regards our species.

The climatic range of a species in the natural field gives, of course, a first clue to its climatic adaptation, but we know now very well that mechanical barriers to progress, inefficiency in transportation, and mere competition with other forms are sufficient to exclude species from a wider field. The black locust is a most striking example, having from a very confined natural field become almost ubiquitous. Moreover, within the broader climatic range the distribution of the species is not only determined by edaphic adaptation, but by local variations of climate, such as are brought about by variable topography. Our species so far have remained largely unstudied from this point of view. Among the minor variable features of local climate it is specially the frost phenomena which are of importance, and knowledge as to what species are liable to suffer or capable of withstanding these, and under what conditions, during various periods of their life from the young seedling to the mature tree, would be most desirable.

The most important of the variable factors of environment in a forest association is the light, and the adaptability to variable light conditions of the members which make up the community is of the utmost interest to the silviculturist, and should be to the plant ecologist.

But, although the physiological relations of light to plant growth have been studied by botanists, the ecologic relations have been hardly recognized. On this field the ecologists owe an apology to the silviculturists for having failed to perceive the importance, which the latter have pointed out and appreciated for the last hundred years.

Almost the whole art of the silviculturist is based on the recognition of photic adaptations of the different species. Schimper, in his plant geography, fails even to indicate the ecologic character of this factor,

consuming the thirteen pages on which he discusses the factor of light entirely, with explanations of the physiological influence, although in passing he mentions its ecologic value as follows:

"The importance of light from the standpoint of plant geography, although in its influence upon form and life of the plant significant, is much less than that of temperature and hydrometeors; the differences in light intensity from climate to climate are insignificant in comparison with these factors. Yet, until Wiesner accentuated this influence it had usually been undervalued. The difference in intensity of light in the different climatic zones and the increasing duration of sunlight from the equator to the poles leave their impression upon the vegetation. Still more important, to be sure, is the significance of light for plant topography, since for the characterization of the single formations of a region the great differences of lighting are important."

But for any expansion on this part, namely, the topographic importance of light, we look in vain.

The relative tolerance or endurance of light among the tree species within a given climatic range is probably the most important ecologic factor which determines the character of the association. The tolerant, if adapted to climate and soil, must ultimately drive out or reduce in number the intolerant or light-needing, even though perfectly adapted to climate and soil. This accounts for the sporadic occurrence in the mixed maple-beech-hemlock-spruce forest of such light-needing species as the black cherry, the ash, the elm. It accounts for the existence of the most intolerant bald cypress or larch in the swamps, where their competitors could not follow. It accounts for the change of forest type under the influence of man, the alternation of species observed on burns and slashings.

An ecological study of the relative shade endurance of our important species is the most important need of the silviculturist.

And so we might enumerate any number of problems of practical importance for the solution of which the practitioner is waiting. And as in other sciences, which were first deduced from empirics and now direct the practice, so for ecology has come the time to direct the practice.

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*WORK OF THE LICK OBSERVATORY.**

THE Lick Observatory suffered an irreparable loss in the untimely death on August 12, 1900, of Dr. James Edward Keeler, director from June 1, 1898. Our appreciation of his worth has not grown dim with time. Dr. Keeler's last observations were made with the Crossley Reflector in the hope of recording the image of a ninth satellite of Saturn, reported to exist by Professor W. H. Pickering. No trace of the satellite was detected, but the plate of June 28, 1900, led to the discovery of an asteroid, 1900 GA—probably the faintest one known.

While the Observatory is preeminently an observation station, yet it is not so in a narrow sense. Success in observational work demands: (1) Knowledge of what has been done by others; (2) knowledge of pending problems, and of the most promising methods for their solution; (3) knowledge as to how observations will be used, and when they should be made, in order that they may bear most efficiently upon the problem. An institution whose efforts were confined strictly to securing observations would soon be making inferior observations. Progressive observers must be acquainted with the theories of their

* Abstract of the Director's Biennial Report, Lick Observatory, University of California, July 1, 1900, to July 1, 1902.

subjects, and must undertake occasional theoretical studies, as well as computations of considerable extent.

The hydraulic engine for turning the dome of the great telescope had been working badly for several years, limiting to an appreciable extent the productiveness of the telescope itself. It was found that the brass feed-cylinders of the engine were badly worn, permitting very considerable leakage, thereby in effect decreasing the hydraulic pressure on the pistons. The cylinders were drilled true, and new piston-heads were provided. It is gratifying to report that the dome and its entire mechanism now perform at least as satisfactorily as they did when new.

The original design of the great telescope did not provide for power to wind the driving clock; it was wound by hand. A Pelton water-wheel was installed for this purpose in 1890, but it never had sufficient power to do the work without assistance from the observer. In the past year the water power has been applied more directly to the wheel. The winding apparatus now acts immediately, without assistance from the observer.

Further to increase its efficiency, Mr. Wright has designed, and the instrument-maker has constructed, a device for turning the water power on and off automatically. This will be put in place in the near future; and it is hoped that the observer's duties in connection with the clock will be confined to starting it in the evening and stopping it in the morning.

The need of a wind screen in the opening of the dome had been felt for many years. The violent vibration of the telescope when the opening was turned toward the wind made it impossible to secure accurate observations. An effective screen was erected in 1901.

The efficiency of the thirty-six-inch equatorial was enormously increased a few years ago by illuminating the setting circles by means of electric lights operated from the eye end, thereby making it unnecessary for the observer to climb the high mounting, as he had theretofore done many times per night. Astronomer Hussey has recently equipped the twelve-inch equatorial (under his charge) in a similar manner, with good results.

Many minor improvements on the mounting of the Crossley Reflector have contributed somewhat to its stability, but the necessity for providing this instrument with a new mounting has become more apparent with time to all who have used it. Director Keeler's remarkable success was achieved at enormous expense of time and physical energy. On the average, it was necessary for him to make four or five exposures on an object before a suitable negative was secured; and in many cases he had to be satisfied with enlarged and elongated star images. His experiences have been those of Assistant Astronomer Perrine, who is now in charge of the instrument. If the mirror were provided with a suitable mounting, observers possessing their great skill should have no difficulty in obtaining three successful negatives out of four attempts. The regents in 1901 authorized the construction of a new mounting, and it is well under way.

A generation ago the astronomer ordered his telescope, and expected it to meet all his requirements. This is no longer sufficient. The wonderful developments of our science call for special instruments to do special work, and the so-called universal instrument is out of date. This is especially true in investigations along astrophysical lines. The successful instrument must have maximum efficiency in the problem to be solved. Every observatory of our class requires an instrument-making shop near at hand. This requirement is

especially pressing here, on account of our unusual isolation.

The shops at the Lick Observatory were entirely inadequate for their purpose, and I decided to utilize the first available funds for their proper equipment. The thoughtful generosity of Mrs. Hearst, regent of the university, has enabled me to complete them sooner than was expected.

The observatory early in 1901 began to publish the results of its observations in the *Lick Observatory Bulletin*. The earlier papers by members of the staff had appeared in various astronomical journals. While this plan relieved the university of expense and considerable labor, yet the vexatious delays sometimes occurring in the issue of important papers, and the appearance of the papers in so many mediums, were serious objections. The new plan has worked well. The bulletins have been supplied gratis to other observatories, to academies of sciences, and to the principal investigators.

The observatory library is growing rapidly, as far as growth by exchange of publications is concerned, but early volumes of several scientific periodicals, early volumes of observatory reports now obtainable only from second-hand dealers, and many standard books, both old and recent, are greatly needed. It is planned to supply a few of the most pressing of these needs in the near future from the funds provided by Mrs. Hearst. The library contains about 5,000 volumes and 4,800 pamphlets.

It was Director Keeler's purpose to secure with the Crossley Reflector satisfactory photographs of about one hundred of the principal nebulæ and star clusters. The portions of his program available for observation in our clear summer weather were practically complete at the time of his death, but those in position during the cloudy winter months were incomplete. We have made it a duty to carry on this work as rapidly as possible. As soon as satisfactory negatives of all the objects have been obtained, the results should be published in the best possible manner.

Visitors continue to come to Mt. Hamilton in great numbers, aggregating about five or six thousand per annum. Provision is made for explaining to them the principal features of the observatory in the day time, and for permitting them to look through the thirty-six-inch and twelve-inch equatorials on Saturday nights. In nearly all cases these privileges are appreciated. This work is useful in many ways, perhaps most of all in its resemblance to instruction along university extension lines.

The daily service of accurate time signals to the Southern Pacific Company has been continued. The signals sounding in all the offices of the system are available to the inhabitants of the regions traversed by their lines: north to Portland, east to Ogden, and south to El Paso.

The total value of gifts to the observatory in the period covered by this report has been $35,200.

Through the continued generosity of Mr. William H. Crocker, a well-equipped expedition, in charge of Acting Astronomer Perrine, accompanied by Assistant Ralph H. Curtiss, sailed from San Francisco in February, 1901, to observe the total solar eclipse of May 18, on the west coast of Sumatra. The ten instruments were duly mounted and placed in perfect adjustment. Fifteen volunteer assistants, Dutch residents in Sumatra, were trained to their duties, and the entire program of photographic exposures outlined for the expedition went through without a hitch. All went well, save that the eclipsed sun was obscured at the beginning of totality by thin clouds, which gradually thickened

during the six and one half minutes of the eclipse. Nevertheless, when the negatives were developed it was found that the observations were extremely satisfactory, valuable results having been secured with all of the ten instruments.

The photographs obtained with the forty-foot camera are admirable, the general features of the inner and middle corona being shown as well as if there had been no clouds. A most interesting and unique coronal disturbance was recorded in position angle 60°. A comparison of the solar photographs with those made on the days preceding and following the date of the eclipse by English observers in India, led to the very important conclusion that the coronal disturbance was situated immediately above the prominent and only sunspot visible on those days.

The spectrographic and polarigraphic results were completely successful, perhaps more so than would have resulted from an unobscured eclipse. They established that the spectrum of the outer corona is identical with that of ordinary sunlight, and therefore that the light of the outer corona is not inherent, but is reflected light originating in the main body of the sun; that the spectrum of the inner corona is continuous, and therefore is not reflected sunlight; that the outer corona shows the strong polarization effects that would be expected to result from its character as reflected light; and that the inner corona gives only slight evidence of polarization, as would be expected from light largely of an inherent character.

Mr. Perrine has carefully examined the plates secured with four cameras for the purpose of detecting any possible intra-Mercurial planets. The instruments gave splendid definition, and in the unobscured areas surrounding the sun stars down to the ninth magnitude were recorded. The search was highly satisfactory for more than two thirds of the area under examination, but the clouds prevented complete success in the remaining one third. All the images on the plates were identified as those of known stars.

The discovery of the minor planet Eros in 1898, and the recognition of the unusual opportunities offered by it for an improvement in our knowledge of the distance of the sun, led to the organization of a cooperative scheme on the part of forty or fifty leading observatories, to secure the necessary observations in the fall of 1900. The Lick Observatory entered energetically upon the program outlined. Astronomer Tucker secured more than two thousand meridian circle observations of the 678 reference stars, required as a basis for the entire problem. The microscopes were read by Dr. R. T. Crawford for about 1,600 of the observations, and he rendered some assistance in the computations, but Mr. Tucker was unassisted in the bulk of the reductions. The prompt completion and publication of this extensive piece of work, long in advance of the appearance of results from other observatories, called forth many expressions of admiration for the energy and skill of the astronomer in charge.

Micrometer measures of the position of Eros were obtained by Astronomer Hussey and Assistant Astronomer Aitken, with the thirty-six-inch equatorial. The former made 832 measures in right ascension, and 896 in declination; the latter 1,650 in right ascension and 729 in declination. Photographic observations were secured with the Crossley Reflector by Assistant Astronomer Perrine, assisted by Fellow H. K. Palmer. They include 344 plates on sixty-three nights for accurate meridian places of the planet; 511 plates on thirty-seven nights for a parallax; 110 charting and connecting plates; total, 965 plates, of which 854 contain short exposures for

measurement, carrying over four thousand images of the asteroid. The measurement and reduction of these plates will be an enormous task. Fortunately, Professor Rees, director of Columbia College Observatory, has agreed to undertake that work. His efficient bureau of measurement and reduction, in immediate charge of Professor Jacoby, has already measured and reduced a number of the plates.

Perhaps the most interesting astronomical events of recent years relate to the new star in Perseus, discovered in Edinburgh on February 22, 1901. The Lick Observatory, in common with all similar institutions, made immediate plans to bring every available resource to bear upon the study of this star. Its position was measured by Mr. Tucker with the meridian circle, and by Mr. Aitken with the thirty-six-inch equatorial on several occasions in the spring and summer of 1901. It is clear from their observations, amply confirmed by those made elsewhere, that the new star is at least as far away as the faint stars surrounding it, and that its motion with reference to the surrounding stars is so slight as to elude detection for the present. The spectroscopic observations by Messrs. Campbell, Wright, Reese and Stebbins were extremely fruitful in results.

A photograph by Wolf, of Heidelberg, on August 23, 1901, had led to the discovery of masses of nebulosity in the vicinity of the new star. A photograph by Ritchey of the Yerkes Observatory on September 20 confirmed and extended the discovery, showing that the new star was apparently situated in a nebulous mass nearly circular in form, and of great extent. The photograph of this region made by Mr. Perrine with the Crossley Reflector on November 7 and 8 when compared with Ritchey's published photograph of September 20, led to the extraordinary discovery that the well-defined nuclei in the nebula were apparently in rapid motion; the magnitude of the apparent motion being at least seventy-five times as great as any sidereal motion previously known. Telegraphic announcement of this discovery was made at once, and intense interest was taken in the subject. A photograph made by Ritchey at the Yerkes Observatory, on November 9, afforded full and independent confirmation of Mr. Perrine's remarkable discovery. Photographs made at intervals throughout the winter have enabled us to follow the motions of the brighter masses.

Later examination of our early photographs of this region, by Mr. Perrine in January, 1902, led to the discovery that two rings of nebulosity surrounding the new star were beautifully recorded on the plate of March 29. We were thus able to extend the history of the phenomenon backward five months.

The nature of the phenomenon is a mooted question. The favorite theory is that invisible masses of nebulosity existed in this region previous to the formation of the new star; and that the great wave of light, sent out when the brightness of the star was at a maximum, was sufficient to illuminate the dark masses and make them visible to us by reflected light. Bearing upon this question, Mr. Perrine secured valuable polariscopic evidences. A photograph of the nebula was obtained after passing the light through a double-image prism, placed at a short distance in front of the plate holder in the Crossley Reflector. Two images of each of the principal nuclei were recorded in such a way as to make it certain that the polarization effects to be expected from reflected light are entirely absent.

The consensus of opinion is that the new star is the result of a violent collision between two dark stars, or between a dark star and a nebula. It can easily be shown that the kinetic energy of two such bodies,

approaching and colliding with enormous relative speed, would be converted into heat in sufficient quantities to transform the dark bodies into incandescent gases. The history of previous new stars had led us to expect that the spectrum would gradually change into that of a nebula, and in this we were not disappointed. For a suitable study of the present nebular spectrum of the new star it was necessary that further and more accurate investigations be made upon the spectra of the well-known nebulæ. These investigations were undertaken with great success by Assistant Astronomer Wright. He determined the positions of many well-known nebular lines more accurately than had previously been done, and a number of very interesting new lines were detected.

Very little attention has been given to the subject of comet-seeking, on account of pressure of work in other lines.

Micrometer observations of comets in the past two years have been secured, as follows:

Comet	*a*	1900,	Aitken	3	nights,	Perrine	4 nights.
"	*b*	1900,	"	10	"	"	3 "
"	*c*	1900,	"	6	"		
"	*a*	1901,	"	2	"		
"	*a*	1902,	"	2	"		

Valuable photographs of comet *a* 1901 were secured by Mr. Perrine at the Eclipse Station in Sumatra. An orbit of comet *b* 1900 was computed by Mr. Perrine, and of comet *c* 1900 by Mr. Aitken. Some very interesting photographs of comet *b* 1900 were secured by Mr. Palmer.

Extensive series of measures of satellites of planets were obtained by various members of the staff, observations being limited in all cases to those most desired by investigators of their orbits.

Two hundred and fifteen observations of the relative positions of the satellites of Saturn were made by Mr. Hussey with the thirty-six-inch equatorial.

Mr. Aitken made the following observations with the thirty-six-inch equatorial:

Satellites of Uranus,	27	nights.
" " Neptune,	13	"
" " Mars,	7	"
Fifth satellite of Jupiter,	2	"

At the request of Professor Newcomb, Mr. Perrine photographed the planet Neptune and its satellite on thirty plates, in January, 1902, with the Crossley Reflector. The measurements of these plates furnish fifty-one determinations of the position of the satellite, with reference to its primary. Photographic methods have been but little used in this line of work, and it is interesting to note that the smallness of the errors of observation justifies the application of the method in all possible cases.

The work with the meridian circle has been most efficiently prosecuted. Since July 1, 1900, Mr. Tucker has obtained 6,500 complete observations. These include observations of Eros comparison stars; of Eros itself; of Nova Persei; and of zodiacal stars, greatly needed at the present time, to be used as a basis for improving the orbits of the major planets.

The manuscript for 'Lick Observatory Publications,' Volume VI., is entirely ready for the printer. The volume will contain results of meridian circle work from July, 1896, to March, 1901, and will include about 14,000 complete observations of 4,500 stars.

Fellow R. T. Crawford assisted in meridian circle work during the years 1898–1901. At the end of his service he received the degree of doctor of philosophy, having taken for his thesis the subject of 'The Refraction Constant at Mt. Hamilton.'

The department of astronomy known as double stars has been most ably advanced by Messrs. Hussey and Aitken. Their programs have been admirably developed and systematized, and results of prime importance have been surprisingly

numerous. It is not too much to say that their discoveries and observations of new double stars, and their measures of known double stars, outnumber several-fold the corresponding output of all other observatories in the past two years. Both observers have devoted a portion of their time to the discovery of new pairs. Mr. Hussey has found 312 systems in the past two years, and 564 since 1898. They may be classified as follows:

Distances between	0″.00	and	0″.25,	41 pairs.
	0 .26	"	0 .50,	103 "
	0 .51	"	1 .00,	123 "
	1 .01	"	2 .00,	128 "
	2 .01	"	5 .00,	168 "
	Over 5 .00,			1 "
	Total			564 "

The corresponding discoveries by Mr. Aitken have been 249 since July, 1900, and 345 since 1898, as follows:

Distances between	0″.00	and	0″.25,	20 pairs.
	0 .26	"	0 .50,	55 "
	0 .51	"	1 .00,	78 "
	1 .01	"	2 .00,	91 "
	2 .01	"	5 .25,	101 "
	Total			345 "

By way of explanation, it should be said that in general the closer the components of a pair the more interesting and important it is. The majority of stars in which orbital motions have been detected are closer than 1″. Up to the present time about 1,500 double stars with distances under 1″ have been discovered at all the observatories. More than one third of these have been found at the Lick Observatory, and more than one fourth of the whole number have been discovered here within the last three years.

Many interesting results have come from the systematic observation of the well-known interesting pairs. Of these, the most striking case is Delta Equulei. It was supposed that its period of revolution was eleven and four tenths years—surpassed in rapidity of motion only by Kappa Pegasi, period eleven and one third years. In the fall of 1900 it was noticed by Mr. Aitken that the components of Delta Equulei were not following the paths marked out for them by the orbit hitherto accepted as substantially final. Mr. Hussey investigated the question of their orbit, making use of all the known observations. He came to the conclusion that the chances were greatly in favor of a period only one half the length of that previously assumed, namely, five and seven tenths years. Systematic observations by Messrs. Hussey and Aitken during the past year have established the correctness of this view. The period of this interesting binary is fifty per cent. shorter than that of any other known double star. Observations of this system obtained with the Mills spectrograph are in harmony with Mr. Hussey's theory.

Mr. Hussey has also in the past two years secured 1,899 observations of W. Struve, Otto Struve, miscellaneous and new doubles.

Mr. Aitken has obtained 1,431 observations, his observing list being mainly composed of known rapid binaries, and other close and difficult pairs. He has likewise computed orbits for 99 Herculis, Zeta Sagittarii and Beta Delphini.

Mr. Hussey completed his observations and discussions of the Otto Struve Double Stars, and his work was issued in the summer of 1901 as Volume V., 'Publications of the Lick Observatory.'

The Crossley Reflector has been busy on practically every good night. In addition to the observations already referred to, Messrs. Palmer and Dall made thirty-three exposures on the nebulæ contained in Professor Keeler's program, in the first half of 1901. Mr. Perrine has since secured twenty-three exposures on these nebulæ, twenty-eight exposures on the Rumford

variable star regions referred to above, and twenty-five exposures for miscellaneous purposes.

A small slitless spectograph was designed by Professor Keeler for use on faint objects with the Crossley reflector. It was completed on the day of his departure from the mountain. It was tested promptly by Messrs. Campbell and Palmer, who found it necessary to use convex and concave quartz lenses in connection with the quartz prism, in order that the rays should be parallel when passing through the quartz prism. These changes were designed by Mr. Palmer, and the instrument was used extensively by him. He secured seventy spectrograms of the smaller planetary nebulæ and of other small objects. Many interesting facts resulted from these observations. I shall refer only to his success in photographing extremely faint spectra. A strong image of the spectrum of Nova Cygni, visual magnitude about 15.5, was obtained with ease. Successful exposures could probably be made on stars at least a magnitude fainter. His photograph of Nova Cygni demonstrates that the spectrum, which was nebular in 1877, has now become continuous, like that of the ordinary stars.

In addition to the observations of Eros, positions of asteroids 1900 GA, Ohio, and Palatia, were determined by Mr. Palmer, from photographs taken with the Crossley reflector. Mr. Hussey secured eight observations of the asteroids Minerva, Edna, 440, and Chicago. Messrs. Palmer and Curtiss have recently secured photographs of several asteroids whose positions were requested.

Three nights per week with the thirty-six-inch equatorial have been devoted to the determination of the motions of the brighter stars in the line of sight, with the Mills spectrograph, during the past six years. The accuracy of the Lick Observatory determinations has steadily progressed until, for the stars containing fine lines, the probable error of a single determination of velocity is only about 0.25 kilometer.

To the list of fifteen spectroscopic binaries discovered prior to Director Keeler's report of July 1, 1900, I desire to make twenty-three additions, as follows:

Beta Herculis,	12 Persei,
Xi Ursae Majoris	93 Leonis,
Delta Bootis,	Beta Scuti,
113 Herculis,	2 Scuti,
Eta Andromedæ,	Kappa Pegasi,
Pi Cephei,	31 Cygni,
Xi Piscium,	Tau Persei,
Xi Prime Ceti,	Epsilon Hydræ,
Delta Equulei,	Alpha Equulei,
Zeta Herculis,	Phi Persei,
Omicron Andromedæ,	Eta Geminorum.
Gamma Canis Minoris,	

These thirty-eight systems have been discovered since 1898.

There is room for reference to only two of the stars on the above list: Zeta Herculis is a short-period visual binary star, completing a revolution in about thirty-three years. The velocity of the principal star in the line of sight is slowly varying. Kappa Pegasi is one of the most interesting visual binaries known, period eleven and one third years. Until the discovery of the true period of Delta Equulei, this was supposed to be the shortest period known. One of the components of Kappa Pegasi is a spectroscopic binary, having a period of only six days.

These binary systems have been discovered in the process of determining the velocities of about 350 stars; in this list of 350 previous observers had discovered three binaries. Without taking into account a list of several suspected binaries, it is apparent that of the brighter stars at least one in every seven or eight is attended by an invisible companion. When we con-

sider that spectroscopic methods are at present capable of discovering only the larger variations, that very few stars of long periods have probably been advantageously observed as yet, and that the velocity of our sun, due to the orbital motions of the planets attending it, has a double amplitude of only two or three hundredths of a mile per second, there can be no doubt that the number of spectroscopic binaries must be very great. It is probable that the star unattended by dark companions will be found to be the exception rather than the rule.

Mr. Wright has computed the orbit of the spectroscopic binary Chi Draconis; Dr. Reese, that of Capella; Director Campbell, that of the variable star and spectroscopic binary Zeta Geminorum; and Dr. Crawford, that of Eta Pegasi.

Dr. Reese investigated the question of the diffraction of light of variable intensity, with special reference to the Mills spectrograph, as a guide in designing a more powerful instrument. He has likewise investigated the cause of the discrepancies between measures of spectrograms made with the violet end to the left, and with the violet end to the right, as a result of which he established the purely physiological cause of the discrepancy.

Dr. Reese has also designed a new mounting for the Mills spectrograph.

Photographs and preliminary measures of several hundred spectra have been made by Messrs. Campbell, Wright and Reese; and a considerable number of definitive measures have been made.

In December, 1900, the director utilized the results obtained for the velocities of 280 stars situated north of −20 declination in determining the speed and direction of the motion of the solar system through space. The result for the speed of the solar system comes out 19.9 kilometers, or 12.4 miles per second. The apex of the motion is in R.A. 277° 30′, declination +20°. The result for speed is very satisfactory. On account of the absence of material from the southern hemisphere, and the consequent irregular distribution of the observed stars over the sky, the direction assigned must be regarded as a rough approximation.

The average velocity in space of the 280 stars is 34.1 kilometers per second. The velocity of the solar system is therefore much less than the average for the other stars.

Another result of great interest is to the effect that the fainter stars are moving much more rapidly than the brighter ones.

The velocities of the stars have been observed to bear all values between sixty miles approach and sixty miles recession per second.

Investigations in this line have been shown to be practically endless, by our measurements of the velocity of the star Groombridge, 1830. A special effort was made to measure its velocity, as this is the star which up to three years ago had the largest known proper motion. Its photographic magnitude is in the neighborhood of 7.5. The results obtained have shown that the observations may be extended by present methods to stars perhaps a magnitude fainter. Stars available for measurement are therefore numbered by thousands. As soon as half a dozen of the eight or ten great telescopes now engaged in this work have been made to produce accurate results, it will be highly desirable that the interested observatories arrange and carry out a scheme of cooperation on a large scale.

From Mt. Hamilton it is possible to secure the speeds of the stars between the north pole and 30° south declination. The stars in the quarter of the sky from 30°

south to the south pole remain unobserved. For many years it has been my desire to organize an expedition to the southern hemisphere for the purpose of measuring the velocity of these stars. With the approval and endorsement of the president, the subject was brought to the attention of Mr. D. O. Mills, who most generously offered to provide funds for constructing the instruments, for defraying traveling expenses, and for paying the salaries of the astronomers engaging in the work.

For this work, a Cassegrain reflecting telescope is nearing completion. The parabolic mirror of thirty-six and one half inches clear diameter and the convex mirror of nine and four tenths inches are being constructed by the John A. Brashear Company.

A powerful three-prism spectrograph, designed by the director for use with the reflecting telescope, is completed. The delicate parts of the mounting were constructed by our instrument-maker, and the optical parts by the John A. Brashear Company. Mr. Wright has submitted the whole spectrograph to severe tests. Its performance appears to be superior even to that of the original Mills spectrograph. A modern steel dome was built for the expedition by the Warner and Swasey Company. The minor pieces of apparatus required have all been provided. It is planned to select a suitable observing station in the vicinity of Santiago, Chili. It is confidently hoped that this work will be at least as fruitful as that carried on with the Mills spectrograph attached to the thirty-six inch equatorial.

The director wishes to make full acknowledgment of the enthusiastic support afforded him by the members of the observatory staff. Every man has been ready to make the most of the opportunities supplied by the splendid instruments, by the unexcelled climatic conditions, and by the excellent policy inaugurated for the observatory by the officers of the University of California.

W. W. Campbell,
Director of the Lick Observatory.

SCIENTIFIC BOOKS.

Der Hercynische Florenbezirk. Grundzüge der Pflanzenverbreitung im mitteldeutschen Berg- und Hügellande vom Harz bis zur Rhön, bis zur Lausitz und dem Böhmer Walde. Von O. Drude. Leipzig, Engelmann. 1902. Pp. xix + 671.

This is the sixth volume in the series of monographs of Engler and Drude under the general title of 'Vegetation der Erde.' Having been specially elaborated by Dr. Drude, it may be taken to represent the standard adopted and the principles which it is designed to embody as the work progresses farther. The region covered includes central Germany, and is familiar to the author, as he tells us, through thirty years of field and herbarium work.

As indicated in previous volumes, the scope of the general work is a study of the vegetation of the earth from the standpoint of geological development, on the one hand, and adaptations to environment, on the other. By a natural division of material and labor, two lines of work have been developed, namely, floristic observations and the study of biological relations. It is to the first of these that the present volume is mainly, though not exclusively, devoted.

The discussion of geographical and climatological data is followed by a brief statistical résumé, in which it appears that, within the limits of the Hercynian region, 1,564 vascular plants occur, besides some 645 species of bryophytes, and possibly 2,000 or more thallophytes. The flora is a composite in which occur numerous Baltic elements associated with northern Alpine forms, and in which north Atlantic species as well as circumpolar Arctic ones are also represented. There are in the whole region but few, and these not strongly marked, species that do not occur in

neighboring regions. The greatest floral contrast exists between the Hercynian flora and that of northwestern Germany; closer relations are manifest toward the east, south and west.

The species composing the German flora are referred to eleven natural areas of distribution, among which are the boreal, Alpine, Ural, Pontic, Atlantic and Arctic. A detailed study of the present distribution of species belonging to these various areas renders possible a discussion of the paths along which the existing floral elements of Germany have migrated at different periods. Naturally, the degree to which the elements from a particular area become dominant determines more or less the tone of the landscape in any given district.

The body of the work is devoted to an account of plant societies, of which thirty-two are distinguished, and to the distribution of these societies and their character species in fourteen natural districts of central Germany The descriptions and enumerations are sc definite and inclusive as to present for every one of these districts a satisfactory picture of floristic relations. The author's contributions and methods in this direction are so well known as to render their present discussion unnecessary.

The fifth and last division of the book is devoted to a consideration of the causes, past and present, that have contributed to the establishment and characteristics of the Hercynian flora as it is to-day. As a matter of fact, 'Hercynia' does not suggest a simple unity as a vegetation region; the unity is rather geographical, and there are included within it a number of vegetation regions which may lie alongside of each other in the plain, and above one another on the mountains. Immigrations have been controlled in the first place by orographic structure and edaphic conditions, determined by the substratum, which consists of crystalline rocks, basalt, and, especially in the west, of Triassic limestone. Climatic factors, in themselves alone, and in connection with physiographic features, and the chances of immigration along natural favorable routes are also all tc be taken into account. It is particularly difficult to form an exact estimate of purely climatic influences on the delimitation of Hercynian districts and landscapes. Westward from the Harz, for example, Atlantic species have settled, favored by the greater amount of moisture, while in the same latitude eastward there is a great development of Pontic groups on the dry triassic soils. The same *Ilex* that grows wild in the neighborhood of the Weser is more likely to freeze in severe winters to the southeast of the Harz. Certain cereals sensitive to excess of precipitation, such as the finer varieties of barley, yield the best harvests along the lower Saale, but all these and numerous other well-known facts are the result of a complex of causes in which general climatic relations must be recognized but are by no means the exclusive factor.

This leads naturally to a discussion of geological relations, which, though brief, is highly suggestive, and is of the more value in that the author, with such abundant data at his disposal, attempts only in the most conservative way theoretical constructions that have often proved of seductive interest. He holds that there is no ground for the assumption that Germany was ever in the condition of Greenland of the present day. Relicts, such as *Hymenophyllum* and various other genera, prove that the last time of glaciation in the Hercynian hill country did not destroy all the remnants of the preceding period. A historical succession may be recognized in which Arctic tundra are followed by a northern steppe flora, which in its turn gives place to forest. Relicts of these different periods are still living together, and in some places have formed remarkably mixed societies.

Drude discusses in some detail the traces of the ice age in subalpine heaths and moors of the Hercynian Mountains, showing that, with the advance of the ice, alpine species as well as the old stock of Scandinavian forms were driven southwards, that finally along the border of the inland ice stretching from the Elbe northeast through Prussia there must have been an exchange of such species, so that hill country, such as that of Hercynia,

lying in the line of this interchange would be settled by. Scandinavian, boreal-Ural and alpine-Carpathian plants. Naturally, also, during the fluctuations of the last glaciation, and especially during the retreat of the ice, a mixture of the highest forest and lowest subalpine societies would take place.

Traces of the steppe period, exemplified in the dry hill and rock plants, correspond with the 'prælpine' societies that occur on the limestone and dolomite slopes of the northern Alps. If we picture to ourselves the time when, after the warm interglacial period, a later glaciation took place, it must be taken for granted that the prælpine grove and rock plants were driven down before the ice and settled on other limestone hills at a lower level. These afterwards mixed in various places with plants of Pontic origin, which also chose dry marl and calcareous soils to settle on. These Pontic elements came in from the east along paths which may still be traced with a considerable degree of assurance. Thus along the Elster, the plants of the Saale (including various prælpine and Pontic species) are not most thickly distributed simply where there is the greatest extent of limestone rocks, but rather in places that these plants could most easily reach, and this depends on the position of valleys free from forests. Along the shortest line from the Saale to the Elster extends a plateau of muschelkalk, and it is exactly in this direction to the eastward that the hills on the Elster reproduce most fully on their south and west sides the flora of the hills along the Saale. Thus the natural geographical paths for post-glacial settlement have been reinforced by favorable edaphic and climatic conditions, and all of these must be taken into consideration in attempting to account for the history of the present Hercynian flora. But until the geological history is more fully and certainly known it is impossible to construct, with any hope of accuracy, such a system as, for example, that attempted by Schulz, who assumes four periods of warmth alternating with as many of glaciation, and undertakes to trace the periods and course of immigration for single species.

Since the glacial period the orographic features of Hercynia have not been essentially altered, and then, as now, climatic and edaphic factors were together determining the immigrations of plants. It is very probable that at the time of the Pontic invasion the region of the lower Saale had a more distinctly steppe climate than other parts of Hercynia, and that the triassic soils which to-day favor the plants inhabiting them offered corresponding advantages to such settlers then. In manifold other ways the continuity of present with past physiographic conditions becomes increasingly obvious, and the present study is a noteworthy recognition of the necessity of admitting this principle to the fullest extent in attempting to construct a satisfactory picture of the historical succession of plant societies. The attainment of such an ideal, though beset with extraordinary difficulties, is being brought nearer through the indefatigable labor embodied in this and the companion volumes of the 'Vegetation der Erde.' V. M. Spalding.

The Archeological History of Ohio. By Gerard Fowke. Columbus, O. Published by the Ohio State Archeological and Historical Society, 1902. 8, XVI.

Mr. Fowke's book is not written, so he claims, for scientists or specialists, but to give laymen an idea of the extent and characteristics of the prehistoric remains found within the borders of the state of Ohio. It fulfils its mission and presents in its 760 pages a complete résumé of all the antiquities of the state, and also refers to nearly every publication upon the subject. The work is well done, and as Mr. Fowke compassed a task which required a great deal of time, and would not have been possible to any person who had not studied the Ohio field, as he has, for twenty years, he is deserving of our meed of praise.

But while the above is true, the book itself may not further the study of archeology in the United States. Unfortunately the author is even more than controversial, he is dogmatic, and to most of the writers and authorities on Ohio antiquities, he is unjust. Such a book as this is, evincing years of study in

its preparation, may do a deal of harm or an equal amount of good. That is, it may give an erroneous conception of the culture of the mound-building tribes in Ohio. A scientific critic should be infallible. Mr. Fowke is not infallible. Beginning with the year 1803 and coming down to the present, he has resurrected the published opinions of scores of writers, and has held up their theories to ridicule and contempt. But they were the pioneers in American archeology. These men made many mistakes. It would be as logical for one interested in the development of steam navigation to contrast Fulton's steamboat with the *Kaiser Wilhelm der Grosse* to the detriment of Fulton, as it is for Mr. Fowke to measure these pioneers by our present standard of knowledge.

The whole tone of the book is that prehistoric man in Ohio is scarcely worthy of study; that nothing new has been learned regarding him; that (p. 148) "Our museums are filling up with material from all these sources, and yet, for years, the accumulation has added nothing in the way of real information to what we already knew."

If this is true, why continue work in prehistoric anthropology?

Mr. Fowke does not believe the prehistoric earthworks and mounds required the time in their construction assigned by other investigators, who made many exaggerations. But he presents a rather illogical argument. I have space for only part of it.

"Forty deck hands on a western steamboat, working steadily, will transfer ten thousand bushels of corn from the bank to the vessel in one day. An equal weight of dry earth will make a mound forty feet in diameter and ten feet high" (p. 85). No Indian ever worked as deck hands work. The corn in sacks and usually handled on trucks, is rushed from the deck into the warehouse, the negroes stimulated to run by the curses of the mate. Mr. Fowke places the natives, who had no shovels, no trucks, and no inclined planes or board floors on which to move the 'dry earth'—even as negroes hustle sacked corn—on a par with the fastest workers of modern times. The field testimony is that the earth for mounds was scooped up in the immediate neighborhood and carried in baskets or skins. This was naturally a slow process, as the natives used stone or shell digging tools.

On page 88 there is a sentence which is calculated to prejudice the author in the eyes of fair-minded men. Mr. MacLean, in one of his books, refers to the mound-builders as selecting the region between the lakes and the gulf, the reason for which is apparent to any observer. As to this opinion, Mr. Fowke says, 'The last quotation is about as sensible as to say that a man displayed great literary inclination by electing to be born in Boston.'

He contends that the number of rings in a tree is no evidence as to its age, to all of which we may subscribe. But, unfortunately, he cites all the trees of rapid growth in support of his argument, even bringing in trees of tropical regions, as in Yucatan, where M. Charnay found trees twenty-two years old two feet in diameter. As to the great oaks four or five feet in diameter, found on some of the earthworks, he has nothing to say.

Mr. W. C. Mills's important investigations of the last few years are almost entirely omitted. In many places Squier and Davis are cited because their measurements are not in accord with those of the author, who ignores the fact that the diameter of an embankment or of a mound may have been enlarged many feet through continuous cultivation. The Hopewell exploration, for example, showed that the Effigy mound was originally much higher and narrower than even in Atwater's time; to-day it is nearly one half larger and broader than it was found to be in 1891. Applying to this Mr. Fowke's method of reasoning, the structure could never have had the dimensions assigned to it by early observers.

The chapter on Flint Ridge gives an exhaustive account of that famous site. The pages devoted to the manufacture of implements and to the finished products are also, with the exception of a few remarks on ceremonial stones, above criticism. In such descriptions and in field work the author is seen at his best, and the critical student would be

unjust did he not accord due praise in these directions. It is only in Mr. Fowke's attitude toward others, in which there is manifest such a spirit of intolerance, that he is open to severe criticism.

His conclusions are that several tribes may have occupied Ohio (p. 470), yet he does not agree with the 'long and short heads' theory.

He uses the terms 'tribe' and 'race' interchangeably throughout his book. He says mound finds and surface finds differ little—a statement not borne out by field testimony. Different sites present varying degrees of culture, and the Turner site where Putnam found so many evidences of a considerable advance in art, and the Hopewell where substances from the Yellowstone, the Gulf and other distinct points, together with beautiful carvings in stone and bone, were exhumed, are classed with sites which evince a very low degree of culture.

No sensible person believes in 'civilization of the Mound-builders' or that there was a 'race of Mound-builders.' But to swing to the other extreme and classify a tribe able to construct the strange 'combination-works' of the Lower Scioto with the Pai Utes or the Comanches is manifestly wrong.

Warren K. Moorehead.

Andover, Mass.

The Minerals and Mineral Localities of Texas. By Frederic W. Simonds, Ph.D., Professor of Geology, the University of Texas. Bulletin No. 5, The University of Texas Mineral Survey, December, 1902. Pp. 104.

In the 'Letter of Transmittal' Dr. Wm. B. Phillips, director of the survey, says: "In view of the deep interest now being shown in the mineral resources of the state, we thought it advisable to issue a special publication dealing with the mineral and mineral localities. Dr. Simonds has been engaged upon this work for some time, and it is believed that the list he now presents covers the entire field as well as it can be done at present."

The task Dr. Simonds set for himself was a very arduous one, and it is to his credit that the list 'covers the entire field as well as can be done at present.' It is by far the most comprehensive, and at the same time authentic, list of the minerals and mineral localities of Texas that has been published, and Dr. Simonds has done the state a real service in putting in accessible form so much valuable information concerning these particular resources of the state.

The minerals are listed alphabetically, with numerous cross-references, and this list covers eighty-four pages of the bulletin. Next follows 'A Summary of the Minerals of Texas by Counties'; then notes on the scale of hardness, specific gravity, streak, luster, fracture; and the bulletin closes with a discussion of 'The Commercial Aspects of Certain Ores in Trans-Pecos, Texas,' by Dr. Wm. B. Phillips, Director of the Survey.

The work is well done, and is worthy of better treatment than it received at the hands of the printer. The poor quality of the paper used and the numerous typographical errors —errors solely attributable to gross negligence on the part of the printer—must be a disappointment to the author. The neglect of the printer to follow 'copy' with regard to proper spacing in a large number of the chemical formulæ is very reprehensible. On page 72 the omission of the letter 'y' in the word pyroxene is inexcusably bad in a list alphabetically arranged, but the insertion, on page 94, of the word 'pounds' instead of the word 'points' under the scale of hardness, is infinitely worse.

H. W. Harper.

February 23, 1903.

SCIENTIFIC JOURNALS AND ARTICLES.

The March number of the *Botanical Gazette* opens with a contribution from the Cryptogamic Laboratory of Harvard University by Dr. Roland Thaxter, entitled, 'New or Peculiar North American Hyphomycetes.' In this, the third paper of the series, he describes two new genera, containing three species, *Heterocephalum aurantiacum, Cephaliophora tropica* and *Cephaliophora irregularis,* illustrated by two lithograph plates.—In the conclusion of his paper on 'Chemical Stimulation and the Evolution of Carbon Dioxid,' Dr. Edwin B. Copeland shows that metallic poisons drive off CO_2 from the carbonates in

the cell sap of water plants, such as *Elodea* and *Ceratophyllum*. This pseudo-respiration under the action of strong poisons is many times as active as the real respiration and makes the study of the latter impossible. Carbon dioxid is also given off from filtered sap expressed from *Elodea* more rapidly than from the living plant. He also finds that the evolution of CO_2 is a feature of the breaking down of protoplasm into mere proteid in death, and that it continues for a considerable time after death.—Professor John M. Coulter and Dr. Charles J. Chamberlain discuss the 'Embryogeny of *Zamia*.' The results of that study, taken in connection with previous work, enable them to arrange the gymnosperms in a developmental series. It appears that the embryogeny of *Ginkgo* is the most primitive among gymnosperms, that of *Cycas* more primitive than that of *Zamia*, while *Zamia* approaches more nearly the Coniferales; that such forms as *Taxus, Cephalotaxus, Podocarpus, Taxodium* and *Thuja* show progressive stages from the embryogeny of *Zamia* toward that of *Pinus;* that *Ephedra* has the most primitive embryogeny among the Gnetales; and that *Gnetum* and *Tumboa* resemble the angiosperms in the elimination of free nuclear division from their embryogeny.—Professor Bruce Fink describes some *Cladonia* formations occurring on the talus of cliffs in northeastern Minnesota. The region is a remarkable one for the growth of these interesting lichens. Photographic illustrations show the way in which the talus blocks are gradually covered with lichen societies.—Mr. Howard S. Reed describes 'The Development of the Macrosporangium of *Yucca filamentosa*,' which shows certain interesting deviations from the mode in other Liliaceæ.—Mr. J. M. Greenman remarks that his new genus *Faxonanthus*, recently described in Sargent's 'Trees and Shrubs,' accidentally without indication of relationship, belongs to the family Scrophulariaceæ, and is allied to the genus *Leucophyllum*.—Mr. A. S. Hitchcock publishes nomenclatural notes upon *Andropogon divaricatum* and *Dactylis cynosuroides*. Küster's 'Pathologische Pflanzenanatomie,' Strasburger's 'Das botanische Practicum,' and Wiesner's 'Die Rohstoffe des Pflanzenreiches' are reviewed, together with a large number of papers in current literature.

The Popular Science Monthly for April opens with a translation of Hugo de Vries' memoir, 'On the Origin of Species.' This is followed by the ninth instalment of 'Mental and Moral Heredity in Royalty,' by Frederick A. Woods, who states that heredity appears to have exercised in mental life a factor not far from nine tenths, while on the moral side it is something over one half. Under the title 'The Great Auk in Art,' Frank Bond gives a considerable series of pictures of this bird gathered from various sources, accompanied by the descriptions of different authors. T. D. A. Cockerell discusses 'The Making of Biologists,' presenting evidence to show that much depends on natural bent and out-of-door surroundings, and Glenn W. Herrick considers 'The Relation of Malaria to Agriculture and Other Industries of the South.' He shows that malaria increases the death rate and that the loss of time it causes is a very serious drawback to agricultural prosperity. Albert M. Reese has an interesting article on 'The Habits of the Giant Salamander,' though the animal referred to is the North American *Cryptobranchus* and not, as one would naturally suppose, the really giant Japanese species. J. Howard Gore has a paper on 'The Carnegie Institution and the National University,' and in 'Biography in the Schools' David R. Major and T. H. Haines present facts implying a decided lack of biographical knowledge on the part of the average student. Charles A. White describes 'A Visit to the Quarry Caves of Jerusalem,' and Sir Benjamin Baker the construction of 'The Nile Dams and Reservoir.' 'The Progress of Science' contains various items of general interest and the index to Vol. LXII. completes the number.

The Museums Journal of Great Britain has an article on 'Voluntary Help in Museums,' suggesting that a museum might obtain much assistance from parties not on its staff, but

interested in its welfare. Ernest Lowe, of the Plymouth Museum, describes 'The Registration and Numeration of Museum Specimens' as practiced in that institution and the editor invites other papers on that subject. 'An Outsider's View of Museums and the Public' suggests that the latter does not appreciate the instruction to be found in museums. The balance of the number is filled with notes regarding British and foreign museums.

The Plant World for March contains the fourth instalment of 'Notes from the Note Book of a Naturalist in Guam,' by William E. Safford; 'Another Use for the Royal Palm,' by William Palmer; 'Spontaneous Fission of Olive Trees in Palestine,' by Charles A. White, and 'Botanizing in a Cactus Bed,' by Charles F. Saunders.

In the *Proceedings of the American Academy of Arts and Sciences* W. E. Castle gives a very clear exposition of the main features of 'Mendel's Law of Heredity,' accompanied by illustrations of its workings. It is only to be regretted that this useful paper is not published where it would be more generally accessible to the many who wish to know just what Mendel's law is, but do not care to spend the time to look up articles relating to it.

Number 9 of Volume V. of the *Memoirs of the Boston Society of Natural History* is devoted to a detailed description of 'The *Skeletal System of Necturus maculatus*,' by Harris H. Wilder. This is accompanied by several plates which admirably illustrate the features of the skeleton. The author hopes that as occasion offers he may add to this papers on other systems of *Necturus* and thus give a complete monograph of a typical tailed amphibian.

SOCIETIES AND ACADEMIES.

AMERICAN PHYSICAL SOCIETY.

The regular winter meeting of the Physical Society was held at Columbia University, New York city, on February 28, 1903.

In a paper on the 'Nucleation of the Atmosphere During Cold Weather,' by Carl Barus, the author presented the results of recent work with his coronal methods of counting the number of condensation nuclei in the air. These nuclei were found to be present in abnormally large numbers during the very cold weather of December and January. Curves were exhibited showing a remarkable parallelism between fall of temperature and rise of nucleation. Three alternative hypotheses were mentioned by Professor Barus in explanation of the results, viz., a current from the upper air rich in nuclei may be brought down by the cold wave; or the formation of water nuclei may bring down an air stratum overlying cities; or the water nuclei may be radioactive at low temperatures and thus produce other nuclei by ionization. Experiments are in progress to test the latter hypothesis.

A second paper by the same author dealt with the 'Ionization and Nucleation of the Phosphorous Emanation.' The results show that while the ionization produced vanishes very quickly, the coronas due to condensation on the nuclei present last for a relatively long period. In this case, therefore, there appears to be no relation between ionization and nucleation.

Professor Barus also described an interesting and simple 'Method of Determining the Ratio of the Velocities of the Ions in Air,' depending on the rate of dissipation of charge from a point. The value obtained for the ratio of the velocity of the negative ion to that of the positive ion was 1.32, which agrees closely with the values obtained by other methods.

A paper on 'Diffusion and Supersaturation,' by H. W. Morse and G. W. Pierce, described quantitative experiments based upon an experiment originally due to Liesegang. When the end of a capillary tube containing a solution of potassium chromate is dipped into a water solution of silver nitrate, the silver nitrate diffuses up into the tube and throws down a precipitate of silver chromate. The silver chromate, instead of growing continuously as diffusion proceeds, forms in distinct layers widely separated in comparison with the thickness of the layers. Measurements were made of the distances between these layers and the time was observed at which each suc-

cessive layer was formed. The results obtained agreed in a very satisfactory manner with the theory of diffusion and made it possible to determine the value of the 'metastable solubility product.' The value found indicated that at the limit of supersaturation the solution contained 145 times as much silver chromate as is required to form a precipitate in the presence of the solid phase.

A paper on the 'Rôle of Thermo-Electromotive Forces in a Voltaic Cell' was presented by H. S. Carhart. The writer considered briefly the theory of a voltaic cell, so far as relates to the properties dependent on temperature, and showed that all these could be completely explained by means of electrolytic thermoelectromotive forces between a metal and the liquid in contact with it. Numerous experiments were described whose results were in agreement with the theory.

In a paper entitled 'A Simple Geometrical Principle and its Possible Relation to a General Physical Theory,' Major J. Millis gave an account of the possible modes by which a number of equal spheres may be grouped. It was shown that the grouping that is symmetrical and capable of indefinite extension by the addition of more spheres is not the arrangement that gives a minimum total volume. The possible bearing of this fact upon molecular theories was suggested.

Dr. J. R. Benton described a 'Method of Determining Internal Resistance, Applicable to Rapid Polarizing Cells.' The method is a modification of that of Beetz and gives more accurate results. It also has the advantage that it can be used for cells of small electromotive force and resistance.

The next meeting of the Physical Society will be held on April 25.

ERNEST MERRITT,
Secretary.

NEBRASKA ACADEMY OF SCIENCE.

THE thirteenth annual meeting of the Nebraska Academy of Science was held in Lincoln, Nebr., January 22 and 23, 1903. President Charles Fordyce, Dean of Nebraska Wesleyan University, presided.

The following papers were read:

'The Causes of Metamorphosis in *Amblystoma tigrinum*,' Dr. J. H. Powers. The metamorphosis of *Amblystoma tigrinum* is not, as has been generally assumed, due to enforced aerial respiration; neither is it affected within wide limits by variations in light or heat stimulus. The active causes are variations in metabolism due to fluctuations in food supply. Sudden checks in food supply lead to immediate metamorphosis, slow and constant food supply postpone metamorphosis and prolong growth in larval stage.

'Sand and Gravel Industry in Nebraska,' Dr. G. E. Condra.

'Summary of Study of fifty-seven Cases of Phenomenal Chest Expansion in Nebraska Schools,' Dr. W. W. Hastings.

'The Diagnosis of Human Parasites,' Dr. H. B. Ward. In this paper Dr. Ward dealt especially with the necessity of more accurate knowledge concerning the eggs of parasites, and concerning the other evidence upon which differential diagnoses might be made.

'Absorption of Starlight by our Atmosphere,' Professor G. D. Sweezey.

'Wave Erosion on the Western Shore of Lake Huron,' Dr. C. H. Gordon.

'A Final Report of the Washings of the Missouri River,' Professor H. B. Duncanson. Professor Duncanson showed the regularity of the shifting of the bed of the Missouri River, and the laws governing the constant gradual backward and forward movement of the channel in the river valley.

'An Old Channel of the Platte,' Dr. G. E. Condra. Dr. Condra, by means of maps and sketches, showed clearly the nature of the broad valley passing from northwest to southeast north of Wahoo, Nebr., which seems clearly to have been a former Platte channel.

'Common Sense and Computation,' Dr. E. W. Davis. A paper devoted to showing errors resulting from continued use of too many decimals in computation.

'On The Paramorphic Development of Hornblende from Augite,' Dr. C. H. Gordon (read by title).

'On the Pyroxenites of the Greenville

Series of Ottawa County, Canada,' Dr. C. H. Gordon (read by title).

'Notes and Descriptions of North American Bees,' Mr. J. C. Crawford, Jr. (read in abstract).

'Florence Flint; Its Production and Uses,' Dr. G. E. Condra. A recently discovered building stone found in southern Nebraska.

'Notes and Descriptions Leading to a Monograph of the Telamonini,' Mr. W. Dwight Pierce (read by title).

'A New Species of *Japyx* from Nebraska, with a Synopsis of North American Species,' Mr. Myron H. Swenk (read in abstract).

'Conditions Serving to Influence the Fauna of Nebraska,' Dr. R. H. Wolcott. The author showed in a general way the geographic, topographic and climatic conditions which tend to produce within the limits of the state a very extensive fauna, and showed the presence of components derived from quite unlike faunal regions.

'Conditions Affecting the Distribution of Forest Trees in Nebraska,' Professor C. E. Bessey. A statement of the conditions which have limited the development of forests in Nebraska in the past, evidences showing the existence of suitable conditions for the future spread of forests in the state, and an examination of the conditions which affect, favorably or unfavorably, this development.

'Madstones,' Professor H. B. Duncanson. Reference to popular theories held in some portions of the state.

'The Development and Distribution of the Human Warble Fly,' Dr. H. B. Ward (illustrated by lantern). An account of several specimens recently secured from Central America.

'A Method for the Study of Peripheral Nerves,' Mr. W. A. Willard (illustrated).

'On the Development of the Pineal Eye of Lizards,' Mr. Willard (illustrated).

Many important items of business were transacted, the most important being measures taken to insure the regular appearance in the future of the *Proceedings* of the society and the limiting of its scope to articles strictly the results of original investigation.

The following officers were elected:

President—Professor Lawrence Bruner, University of Nebraska.

Vice-President—Mr. Wm. Cleburne, Omaha, Nebr.

Secretary—Dr. Robert H. Wolcott, University of Nebraska.

Treasurer—Mr. Geo. A. Loveland, United States Weather Service, Lincoln, Nebr.

Board of Directors—Mr. Charles Lobingier, Omaha, Nebr.; Dr. A. S. Von Mansfelde, Ashland, Nebr.; Professor H. B. Duncanson, State Normal, Peru, Nebr.

Somewhat over forty members and many visitors were in attendance and the meeting resulted most successfully.

Robert H. Wolcott,
Secretary.

New York Academy of Sciences. Section of Anthropology and Psychology.

The regular meeting of the section was held March 23, Professor Thorndike presiding. The first paper was presented by Dr. Clark Wissler, 'Observations on Abnormalities of the Hard Palate.' The paper reported progress in the measurements of the casts of the hard palates of idiots. The first thing to be considered in this work was the determination of the significant points and dimensions in the palate. The results presented indicated important structural relations between the width at the canine teeth and the length of the palate measured from the first molars and the maximum height of the arch. The comparative study of the palates of normal and of idiotic persons will be based upon these measurements.

Dr. A. Hrdlicka then read a paper, 'Physical Anthropology of the Hyde Expedition in 1902.' During 1902 Dr. Hrdlicka made two expeditions, one of seven and the other of three months' duration, to the southwestern United States and Mexico. These expeditions were the conclusive ones of a series of five, begun in 1898, made for the purpose of ascertaining the physical characteristics of all those present as well as extinct tribes which occupy or occupied the region marked by the boundaries of the ancient Pueblos, Cliff-

Dwellers and Nahuan (Toltec, Chichimec, Aztec) peoples. The region thus bounded extends uninterruptedly from Utah and Colorado to the Mexican states of Morelos and Guerrero, and in it live at present a little over forty tribes or distinct groups of Indians. About nine tenths of all these peoples were visited on the five expeditions and examined; all the measurements and data secured are being studied, but to arrive at detailed results will require several years.

What can now be safely stated is: (1) All the ancient as well as the modern peoples in the region mentioned belong to three physical types, and these types are identical with those widely represented in all directions outside of this region; and (2) a very large majority of the present peoples examined are physically identical with the prehistoric inhabitants of these same districts (so far as could be ascertained from the osteological material recovered); the prehistoric remains (osteological) show no type that is not represented somewhere in the region covered to-day, and there is no type among the living tribes not represented among the ancient ones.

The visit of so large a number of tribes, as well as the search for skeletal remnants of the extinct peoples, afforded a very good opportunity for general ethnological and archeological observations, the substance of which can be stated as follows: The Mexican Indians visited, with the exception of the Huichols and Tarahumares, are in their mode of life and habits far more like the whites about them than is the case with our Indians of the southwest; nevertheless, the Mexican tribes preserve much that would be of value to the ethnologist. Dr. Hrdlicka's exploration in northern Jalisco and in Zacatecas resulted in the discovery of the ruins of eleven good-sized pueblos or towns, the excavations at one of which showed that its inhabitants had reached a comparatively high grade of culture. The pueblo and cliff ruins of our southwest may be compared to a head which connects by a long narrow neck running through Cora Grande in Arizona, Coras Grande in Mexico, Zape in Mexico and La Quemada in Zacatecas, with a large body of ruins which begin in southern Zacatecas and Jalisco and extend through all the southern part of Mexico to Guatemala and Central America. La Quemada was found to be above all a fort, in all probability the most representative stone-built native fort in North America.

In Zacatecas Dr. Hrdlicka discovered a colony of Tlascaltecs, transplanted hither by the Spaniards in the seventeenth and eighteenth centuries; and further south he found two villages still occupied by the remnants of the ancient Chichimecs of Teul. South of Juchipilla, in Zacatecas, is located a perfect cliff-dwelling, probably the most southern one in existence. This particular ruin, known under the name of 'Las Ventanas' (the windows), has been visited by at least one American before, namely, by Miss Britton.

JAMES E. LOUGH,
Secretary.

NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

AT the meeting of the section on March 2, Professor Wm. Hallock read a paper on the 'Measurement of the Altitude of Mount Whitney, California, by Boiling-point Determinations.'

At the time of the ascent of Mount Whitney last summer by the party under Mr. Harrington Putnam, apparatus was taken to the top, and a determination of the boiling point was made at ten o'clock on August 23. The observed boiling point was 186°.47. Applying the instrumental corrections and reducing this by the Smithsonian tables, the corresponding barometric pressure was 17.70 inches. The Weather Bureau kindly furnished the barometric pressure, temperature and vapor tension for Independence, California, for that morning. They were: barometric pressure, 25.93 inches; temperature, 78°.0, vapor tension, 0.110 feet. Substituting these values in the formula given by Bigelow on page 490 of the second volume of the annual report of the 'Chief of the Weather Bureau' for 1898–99, a difference in altitude between Independence and Mount Whitney of 10,633 feet results. Inasmuch as this determination was made five feet below

the actual summit of the mountain, and Independence is 3,910 feet above sea-level, it would give a final value for the elevation of Mount Whitney of 14,548 feet. It may be stated in this connection that the value which was obtained by Secretary Langley as a result of a very complete series of determinations was 14,522 feet. Of course, this coincidence is accidental, as the probable error in either case is undoubtedly not less than ten or fifteen feet. One object of this determination was to show the availability of boiling-point apparatus, which is light and convenient for such determinations, as being very much more reliable than the aneroid barometer, and much easier for transportation than the mercurial barometer.

A second paper was read by Dr. S. A. Mitchell, on 'The Discovery of New Gases in the Sun,' in course of which it was shown that the interdependence of the sciences is nowhere better illustrated than in spectroscopic work, when astronomy, the most ancient of all the sciences, goes hand in hand with physics to find a new chemical element. In recent years, through spectroscopic researches, several metals have been added to the list of elements. In April, 1895, by investigations on a specimen of clevite, Ramsay announced the discovery of terrestrial helium which gives a line in its spectrum agreeing with the D_3 line, familiar for more than twenty-five years in stellar, prominence and chromospheric spectra. About the same time, Rayleigh and Ramsay announced the discovery of another new element which was called argon. In the early summer of 1898, Ramsay found two more gaseous elements, neon and krypton, and subsequently a heavier gas to which the name xenon was applied. These five new elements, helium, neon, argon, krypton and xenon are found in atmospheric air, and can be obtained from air by fractional distillation by making use of the extremely low temperatures of liquid air and liquid hydrogen. Atomic weights have been assigned as follows: helium, 4; neon, 20; argon, 40; krypton, 82, and xenon, 128; and the gases seem to form a series in the periodic table of elements between the fluorine and sodium groups.

Investigations carried out on photographs of the 'flash' spectrum at the Sumatra eclipse of 1901 enabled Dr. Mitchell to find that the remarkable variations in the intensities of the lines of the ordinary solar spectrum and of the 'flash' spectrum (for one does not *look* to be the reversal of the other) are due to the different *heights* to which the vapors of the various metals ascend above the sun's surface. As a consequence, although helium lines are not found in the ordinary solar spectrum, the helium lines in the spectrum of the chromosphere are very bright, indeed.

In view of the similarity of the new gases, neon, argon, etc., to helium, and as the helium lines are such prominent ones in eclipse spectra, it was expected that the new atmospheric gases—at least the lighter ones, neon and argon—might appear in the sun's atmosphere. A detailed comparison of the lines of the flash spectrum measured by Dr. Mitchell with those of the new gases lately published has led to the discovery that neon and argon are both present in the chromosphere, while it is doubtful whether krypton and xenon are there or not.

S. A. Mitchell,
Secretary of Section.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

March 6.—Dr. Julien showed some very large chlorite pseudomorphs after garnet from the Spurr mine, Marquette, Mich., a single crystal measuring almost four inches in diameter. Professor Grabau reviewed Dr. A. E. Ortmann's paper on 'The Geographical Distribution of Fresh-water Decapods and its Bearing upon Ancient Geography.'

March 13.—Dr. A. F. Rogers discussed crystal habit and methods of expressing it. Dr. Julien reviewed a paper by M. J. Fuller in the *Journal of Geology* (November–December, 1902) on the etching of quartz in the interior of conglomerates. Professor Grabau reviewed from the *American Journal of Science* (August, 1902) a paper by W. M. Davis on the terraces of Westfield River of Massachusetts.

March 20.—The following papers were reviewed: Charles Schuchert, 'On the Manlius

Formation of New York' (*American Geologist,* March, 1903); B. E. Livingston, 'The Distribution of the Plant Societies of Kent County, Mich. (Mich. Surv., 1901), by Professor Grabau. Stuart Weller, 'The Composition, Origin and Relationships of the Corniferous Fauna in the Appalachian Province of North America' (*Journal of Geology,* May–June, 1902); G. F. Matthew, 'Notes on Cambrian Faunas' (*Trans. Roy. Soc. Can.,* 1902–03), by Miss Florence Henry.

H. W. SHIMER.

NEW YORK SOCIETY OF BIOLOGY TEACHERS.

THE third meeting of the academic year was held Friday, January 30, 1903, at 8:15 P.M.

The topic for the evening's discussion was 'The Public Scientific Institutions and the School System.' Dr. H. C. Bumpus, of the American Museum of Natural History, opened the discussion. He said, in part, that certain of the collections had been directly planned with a view to helping teachers and students, that rooms and a working library had been set apart for their use, and that sets of guide leaflets had been issued for the express purpose of making the collections more directly available to the teaching public. He then indicated how certain exhibits might be arranged to cover a number of special subjects, and especially to bring the museum into use as a factor of public instruction in matters of current interest.

Dr. N. L. Britton then explained in detail to what extent the New York Botanical Gardens were available to teachers and students. Especially with reference to the trips under guidance of a detailed official, the permanent microscopic exhibit, the arboretum, the museum and public lectures, the garden was of practical assistance to the teacher. It was hoped later to furnish some plant material free to the board of education.

Dr. C. H. Townsend called attention to the fact that the New York Aquarium was already cooperating with the high schools of the city to the extent of setting aside material and balanced salt-water aquaria for them, and in closing the aquarium to the public for two days in the week to allow classes from the schools to work in quiet. He furthermore offered to supply the schools with invertebrate material as needed in cooperation with the board of education.

Dr. A. G. Mayer pointed out some practical examples of what was being done by the Brooklyn Institute of Arts and Sciences for the schools, and gave his ideals of a children's museum which should be incorporated in the museum.

After the regular program a general discussion followed, with this practical result: A committee was appointed by the president of the association to endeavor to obtain, so far as possible, the fullest cooperation between the public scientific institutions and the city schools.

The following officers were elected to hold office for 1903:

President—H. A. Kelly, Ethical Culture School.
Vice-President—Miss K. B. Hixon, Morris High School.
Secretary—G. W. Hunter, Jr., DeWitt Clinton High School.
Treasurer—Miss I. M. Clennedin, Girls' High School, Brooklyn.

G. W. HUNTER, JR.,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE TYPES OF LINNÆAN GENERA.

THE interesting note of Mr. O. F. Cook, on the 'Types of Pre-Linnæan Genera' (SCIENCE, February 27, 1903, p. 350), touches the most important question still unsettled in the nomenclature of animals and plants. We have yet to agree on a means of fixing the type for the genera of the earlier writers, our conception of a genus being necessarily that of a cluster of species grouped around the type species of a genus. The fixation of type by elimination is an utter failure, as Mr. Cook has pointed out. It is impossible to define this process so as to bring out the same result in different hands and in different groups.

We have already recognized that the selection of names must not in any degree be left to individual choice. We must agree that the choice of the type of the genus must be made

with sole reference to the author in question and his sources of knowledge, and that the operations of subsequent writers are not to be considered. In choosing types for Linnæan genera, we must settle the matter with Linnæus himself, considering only his purpose, the knowledge he possessed and the sources whence he drew his information.

We have rarely any difficulty in indicating the species Linnæus would have chosen had he adopted the idea of type. To a certain extent he did recognize this idea, and he tells us that in each genus his type 'is the best known European or officinal species.' When he took his genera from Tournefort or Artedi, he presumably took the idea of type also, and to find this we may well look back to these earlier and greater naturalists.

In Linnæus's arrangement, the type was usually placed in the middle of the genus, for he was developing a system of catalogue and record. But nearly all subsequent authors have, under each genus, spoken first of the species they knew best, that which we should call the 'type.' Cuvier and his followers place as the 'chef de file' the type species or best-known form, describing it fully, letting the other species follow with shorter or comparative descriptions. Various authors have chosen Linnæan specific names for their genera, the species thus honored being clearly recognizable as the 'type.'

We may adopt as fair some such rule as this: The species first named under the description of a genus shall be regarded as its type unless, as with Linnæus, the context shows that some other species was or would have been chosen by the author, or unless the name of the genus is drawn from a Linnæan or other early specific name.

To take the first species in all cases, not even excepting the case of Linnæus, would have distinct advantages over the present lack of system or over the confusion arising from the method of elimination or from any other device which throws the responsibility on subsequent usage.

David Starr Jordan.

Ridgway's Classification of the Falconiformes.

Nothing could be more gratifying to the advanced ornithologist than the vindication of Mr. Robert Ridgway's excellent classification of the diurnal birds of prey through the recent independent researches of foreign investigators.

However, when Mr. Ridgway seems to think that his arrangement, published 1873–76, 'so radically different from any other, found little favor among ornithologists and has generally become forgotten' (see Science, N. S., XVII., March 27, 1903, p. 510), he has evidently overlooked the fact that its essential points have been adopted by practically *all* his American colleagues.

The American Ornithologists' Union committee on classification and nomenclature in the spring of 1885, when preparing the now celebrated A. O. U. check-list of North American birds, had to decide what classification to follow. The present writer had then recently promulgated a new system of the entire class of birds, and several of the members were in favor of its adoption without modification. The majority, however, believed this to be a too radical departure from the then accepted standards to be palatable to the large number of amateur ornithologists forming the bulk of the A. O. U. membership. On the other hand, it was admitted that the Sundevall-Lilljeborg system then in vogue had become too antiquated to serve without serious changes. The writer, who was present by invitation as a consulting member without vote, was then requested to frame a compromise scheme which would eliminate some of the worst features of the old system without deviating too violently from it. The result was the classification still adhered to in the A. O. U. check-list.

The arrangement of the birds of prey in that list is briefly as follows:

Order RAPTORES. Birds of Prey.
Suborder SARCORAMPHI. American Vultures.
Family Cathartidæ. American Vultures.
Suborder FALCONES. [Old World] Vultures, Falcons, Hawks, Buzzards, Eagles, Kites, Harriers, etc.

Family FALCONIDÆ. Vultures, Falcons, Hawks, Eagles, etc.

Subfamily *Accipitrinæ*. Kites, Buzzards, Hawks, Goshawks, Eagles, etc.

Subfamily *Falconinæ*. Falcons [including the Caracaras].

Subfamily *Pandioninæ*. Ospreys.

It will be seen that this scheme of 1885 is essentially that of Ridgway (1873–76), the only difference being that *Pandion* was given a somewhat more independent position, easily explained by the fact that the whole, as shown above, was to some extent a measure of compromise. The Accipitrinæ are otherwise identical with Ridgway's Buteoninæ containing, as they do, the Old World vultures, the eagles, kites, buzzards, etc.

I must, therefore, claim for the American ornithologists the honor of having appreciated and followed Ridgway's classification of the Falconiformes for eighteen years.

The Old World ornithologists, as a whole, it is true, have been lagging behind. Yet, there are noteworthy exceptions. Thus, I would call attention to a very important paper by Mr. P. Suschkin in the *Zoologischer Anzeiger* for 1899 ('Beitraege zur Classification der Tagraubvoegel mit Zugrundelegung der osteologischen Merkmale,' *Zool. Anz.*, 1899, pp. 500–518), in which he, three years before Pycraft's work, commends and adopts all the essential features of Ridgway's scheme which his own investigations on forty-four genera corroborate, elaborate and partly correct.

LEONHARD STEJNEGER.
U. S. NATIONAL MUSEUM,
March 28, 1903.

HOTEL HEADQUARTERS OF THE AMERICAN ASSOCIATION.

TO THE EDITOR OF SCIENCE: While traveling homeward after the recent meeting of the scientific association I spent some time, which would otherwise have been hanging heavily on my hands, in studying out a few of the relations indicated by the registered list of attendance. This list included 972 names, a number somewhat less than the total registration, but the difference is not great enough to have any important effect on results.

The question for solution was this: "What is the meaning of 'hotel headquarters'?"

It has been the custom for a dozen years past to designate some hotel as headquarters. This hotel has been conveniently near to the places of meeting of the sections, and in it the council of the association held their meetings. A majority of the council usually secured their rooms at headquarters, and it was generally understood that the social advantage implied in taking up one's temporary abode with a majority of the most prominent members present was more than an offset for the expense of accommodation at a fashionable hotel. This item of expense is one that is unfortunately more important to most followers of pure science than to the captains of industry who reap the benefits of applied science and 'legislative favors.' The hotels have, until recently, been disposed to make such reduction in rates as to constitute an inducement to make hotel headquarters the real headquarters of the association.

To the rule just named there have been a few conspicuous exceptions, as at the Buffalo meeting in 1896 and the Pittsburgh meeting in 1902. Every hotel proprietor has a perfect right to offer or refuse reduction of rates; but it is at least desirable that such hotel be chosen as to make it reasonably probable that a large percentage of members will find it advantageous to select the same gathering-place.

Of the 972 persons whose names were included in the Washington list under examination 352 were residents of Washington, and hence a trifle over 36 per cent. of those registered are naturally excluded from the body of temporary residents at hotels. The attendance at the largest five hotels is given in the following table, where the 'hotel headquarters' leads the list.

Arlington	55,	or	5.7	per	cent.
Ebbftt	134,	"	13.8	"	"
New Willard	27,	"	2.8	"	"
Raleigh	24,	"	2.5	"	"
Oxford	21,	"	2.2	"	"
	261		27.0		

This shows that more than two thirds of those present at the Washington meeting avoided the larger hotels. But what is most noticeable is that there were only about two fifths as many registered at headquarters as at another hotel. The meetings of the council were not held there, and not more that half a dozen members of the council made it their stopping place. More than one person who had gone to headquarters in the hope of meeting friends soon went elsewhere. The announcement in the preliminary circular that the Arlington would be headquarters proved to be unfortunate. At Pittsburgh last summer local conditions caused 165 out of the 431 persons present, or about 38 per cent., to meet the high charges imposed at headquarters.

This statement of facts must not be interpreted as an implied criticism upon the management of the local committee at Washington. The permanent secretary has been so systematic, energetic and courteous, that it would be hard to find any reasonable ground for criticism. All that is intended is to call attention to the fact that, under the conditions that appear now to exist, the custom of specifying any place as headquarters seems one 'more honored in the breach that the observance.'

W. Le Conte Stevens.

Lexington, Va.,
January 14, 1903.

PROCEEDINGS OF THE AMERICAN ASSOCIATION.

To the Editor of Science: In your issue of March 13 W. J. Beal makes a plea for the publication in full of all the papers read at the meetings of the American Association for the Advancement of Science in the *Proceedings* of the Association. I must enter a protest against this. I should be entirely unwilling to have my recent paper on 'Abelian Functions and their Relation to the Specific Gravity of Sirius' buried in the *Proceedings*, where it would never meet the gaze of most of my astro-mathematical friends. Nor do I care to wade through dozens of pages about the 'Stero-isomerism of Azonium Derivatives,' and the 'Ecology of the Dominican Thelophoraceæ' in order to find a few pages of interest to me on skew helicoids.

No, the *Proceedings* should contain merely the titles of the papers read, with a reference to where the original is to be published; a brief abstract of every paper should appear in Science; but the papers in full should be published only in the special journals where they belong and where they will meet the eyes of those, and those alone, who are particularly interested in them. Of course there are some papers read in the sections which are of more than technical interest. For such the columns of Science are the fitting place, for here they will reach the eye of every member of the association. X.

SHORTER ARTICLES.

ADDITIONAL SPECIMENS OF THE JAPANESE SHARK, MITSUKURINA.

In a recent number of the *Japan Daily Advertiser* (Yokohama, March 4, 1903, page 5) there is a notice, and it deserves record in Science, of the capture of additional specimens of the deep water shark, *Mitsukurina*.

Students of fishes will recall that in 1898 Dean Mitsukuri, on the occasion of his visit to Washington as a delegate to the International Fur Seal Conference, brought with him a shark which caused considerable comment. This specimen had been taken in deep water off the Bay of Tokyo; then it came into the hands of Mr. Alan Owston, a resident naturalist of Yokohama, and by him it had been presented to the Imperial University of Tokyo. A detailed account of this new shark soon appeared in the *Proceedings of the California Academy of Sciences*, Ser. 3 Zoology, Vol I., pp. 199–204, 1898, and it was here described by President Jordan as *Mitsukurina owstoni*, and regarded as the type of a distinct family of lamoid sharks. The most prominent features of the new form were the elongated and spatulate snout, the great extent of the ventral lobe of the tail and a general looseness of make-up, notably in its protractile and expansible jaws. The form was evidently from deep water, and structurally it seemed to be a close ally of *Odontaspis*, so close, indeed, that we are still in doubt whether

Dr. Jordan was justified in regarding it as representing a distinct family. Of general interest the specimen certainly was, however, from its grotesque appearance. But the feature which gave it especial value to the student was its resemblance to a shark of the Cretaceous period, *Scaphanorhynchus,* generally assumed to be extinct. Was it possible, then, that this Cretaceous shark was still living in Japanese waters? And if this were true, might it not occur in other deep-sea regions, like its more ancient relative, *Chlamydoselachus?* Thus we find that Dr. Arthur Smith Woodward, of the British Museum, commenting (1899) upon *Mitsukurina,* is distinctly of the opinion that the new genus was but a synonym for the Cretaceous shark, and he gives the evidence in favor of this view in the *Annals and Magazine of Natural History* (7), Vol. III., pp. 487–489, and makes out a fairly convincing case of identity. Nevertheless, we have to admit that the characters of the fossil shark are as yet too imperfectly known to warrant a definite judgment, and the safer course, therefore, is to acknowledge for the present the validity of the name *Mitsukurina.*

The note in the Japanese paper announces that more specimens of this shark have been taken, and we have promise, accordingly, that better anatomical data may be looked for. For one thing it now appears that the specimen first studied was an immature one, no examination of the soft parts having been made. The latest specimen in the hands of Mr. Owston measures, *mirabile dictu,* about twelve feet in length and its weight is estimated as between four and five hundred pounds. This extreme size, it will at once be seen, ranks this shark as one of the largest members of deep-water ichthyic fauna, and it is possibly the most formidable member of its community.

The depth at which the specimen was taken is not stated, but from the conditions of fishing near Numazu, the fish was apparently taken in water deeper than three hundred fathoms. As a symptom of its living at a great depth one notes in the latest description of the fish, that its 'flesh and skeleton are extremely limp, folding like a wet rag.' The color of the fresh specimen is described as 'light reddish-brown, the fins darker brown; nuchal region a little darker, and belly paler.'

BASHFORD DEAN.

EARLY INSTANCE OF TANGIBLE LIP-READING.

AN interesting feature of the autobiography of Miss Helen Keller is the account by her teacher, Miss Sullivan, of her patient efforts to train her young pupil to receive and communicate ideas by tangible lip-reading. Most persons regard the education of blind deaf-mutes as a development of modern philanthropy, and it will surprise many to learn that the method of tangible lip-reading was invented nearly two hundred and thirty years ago.

Bishop Burnet, the famous English historian and theologian, in a letter dated Rome, December 8, 1685, and addressed to the eminent scientist Hon. Robert Boyle, wrote as follows:

> There is a minister of St. Gervais—Mr. Gody — who hath a daughter that is now sixteen years old. At a year old the child spoke all those little words that children begin usually to learn at that age, but she made no progress; yet this was not observed till it was too late, and as she grew to be two years old they perceived then that she had lost her hearing, and was so deaf that ever since though she hears great noises yet she hears nothing that one can speak to her. But the child hath by observing the motions of the mouths and lips of others acquired so many words that out of these she has formed a sort of jargon in which she can hold conversations whole days with those that can speak her own language. I could understand some of her words but I could not comprehend a period [sentence]; for it seemed to me a confused noise. She knows nothing that is said to her unless she seeth the motion of the mouths that speak to her, so that in the night when it is necessary to speak to her they must light a candle.
>
> Only one thing appeared the strangest part of the whole narrative. She hath a sister with whom she has practiced her language more than with any other; and in the night, by laying her hand on her sister's mouth she can perceive by that what she says and so can discourse with her in the night. It is true her mother told me this

did not last long, and that she found out only some short period in this manner, but it did not hold out very long. Thus this young woman hath merely by a natural sagacity found out a method of holding discourse that doth in a great measure lessen the misery of her deafness. I examined this matter critically, but only the sister was not present, so that I could not see how the conversation passed between them in the dark.

The bishop's language will be clearer if we replace his word 'period' by the word 'sentence.' This passage occurs in a volume entitled 'Some Letters Containing an Account [of travels] in Switzerland, Italy [and] Germany in 1685 and 1686,' by Gilbert Burnet, London, 1687 (another edition, 1724), 1 Vol., 8vo.

Henry Carrington Bolton.

MARY LOUISE DUNCAN PUTNAM.

Mrs. Putnam is dead. To those of us who saw her recently, active and happy, the news comes as a shock. But, for her, the end was beautiful; in the midst of her life interests, without shrinking or suffering, at the close of a day of work, she lay down to rest.

Mary Louise Duncan was born at Greencastle, Pa., September 23, 1832. Her father, Joseph Duncan, was, at the time, the only Congressman from Illinois, with his home at Jacksonville. Later he was Governor of Illinois and was influential in shaping the trend of affairs in what was then the Far West. On her mother's side also Miss Duncan was of distinguished ancestry, being the great-granddaughter of that brave woman, Hannah Caldwell, of Revolutionary fame. In her father's home and at Washington, Miss Duncan enjoyed every opportunity and came into contact with men and women who planned and carried out great enterprises. In 1854 she married Charles E. Putnam, of Saratoga Springs, New York, and the young couple at once removed to Davenport, Iowa, which was, from that time on, their home. Mr. Putnam was a man of brilliant mind and talent, who, as a lawyer, soon won name, fame and influence in the new home.

Through her life Mrs. Putnam was actively interested in every good work. Her connection with many public and private enterprises deserves mention. But for us her relation to the Davenport Academy of Sciences is of chief importance. Mrs. Putnam was the mother of eleven children; she was devoted to the interests of each and all; with keen sympathy she entered into every child plan of work or play—the garden, the printing press, the family newspaper, the home dramatic performances. In every device of her children she found some helpful stimulus. She was more than an ordinary mother; she was the companion and confidant of each of her flock. So when her oldest child, a boy of fourteen, longed to join the newly founded Academy of Sciences, he demanded that the sharer of his joys, his mother, should also join. She was the first woman member. Joseph Duncan Putnam was a remarkable boy. At fifteen he was the secretary of the academy; before he was a man in years he was known by all the leaders in entomology; at twenty-five he was a recognized authority on some of the least known groups of insects; at twenty-six he died. His ideals for the academy, to which he was absolutely devoted, were high. He urged permanence—a building, a publication, an exchange and contact with the outside world of science. He lived long enough to see the building and to know that the printed *Proceedings* of the academy were prized at home and abroad. In all his work and plans his mother stood ever near. When money was necessary she canvassed the city; when people would not give, she planned and carried out public meetings, lectures, entertainments; in some way, in spite of discouragement and rebuff, she won the day.

And when her son died she devoted herself to rearing his perpetual monument, in the academy. Through dark years, which would have daunted all but a mother's love, she has toiled, and she has succeeded. The academy lives and will live. Through her interest a publication fund, memorial to her son and her husband, was secured, and the *Proceedings* have been continuously published. The volumes contain important contributions in all fields, but prominent among them are those

in entomology, by masters who had known and loved young Putnam. Mrs. Putnam, convinced of future development, insisted on securing for the academy additional land and a church property, which, rechristened as *Science Hall*, now houses part of the museum collections and supplies an audience room for public gatherings and scientific lectures. Through her urgency a year ago, a curator was called that more and aggressive work might be undertaken. To-day the Davenport Academy of Sciences has its valuable land, two buildings, important collections, eight volumes of published *Proceedings*, endowed publication fund, small but growing general endowment, an active and competent curator, because *she* has rallied the little band of workers through dark days and has encouraged them when they might falter.

Within the last two years the academy has undertaken much new work. Its desire is to come into a close and helpful relation with the general work of education of the city. Before the new curator, Mr. Paarmann, was called, Miss Sheldon, the corresponding secretary, reestablished the long discontinued lectures to school children at the academy's museum. Since the arrival of the curator, Mr. Paarmann and Miss Sheldon have continued this important work, with gratifying success. In this work Mrs. Putnam was greatly interested and heartily sympathetic. She was enthusiastic also in establishing courses of scientific lectures. The first of these was given in the winter of 1901–02; the second was presented during the season just closing. They were well received and proved more than self-supporting. With delight, Mrs. Putnam, as president of the academy, watched the development of work, the growth of plans, the increasing interest of the community. In February, after the lecture course was closed, she turned her attention to an exhibition of Indian basketry, to be arranged at the academy, for its benefit. All preparations were completed, and on February 19 the doors were opened. The exhibition was to continue through three days and its success was ardently desired. Unexpected numbers came the first and second days and went away delighted. On the night of the 20th, after a busy and happy day at the exhibition, pleased and satisfied at the result and looking forward to an even better morrow, Mrs. Putnam went to her home. A little wearied, she lay down to rest; without a word, and probably without suffering, she passed away.

Mrs. Putnam made no pretensions to be a scientist. But she knew almost every prominent scientific worker in our country and many of the foreign students. She loved to attend the gatherings of the American Association and other organizations, that the academy might keep in touch with the world of science. In October last she was in attendance at the Congress of Americanists in New York. Though she was not present, the American Association for the Advancement of Science, in its December meeting at Washington, elected her a fellow. This unsolicited mark of esteem greatly pleased her, though she felt herself undeserving of it. To whom, however, could it have been more worthily given than to her who had striven so loyally for the advancement of science?

In her death, the object of so much love and labor was not forgotten. The whole of her estate is left for the academy's benefit. Through the provisions of her will $24,000 are available for the continuance of publication of its volumes of *Proceedings*. The academy will continue to touch the outside world of science. Thus, though dead, they speak—the mother and the son, once more united.

FREDERICK STARR.

THE ROYAL GEOGRAPHICAL SOCIETY.

WE learn from the London *Times* that the society will this year make its awards as follows: The Founder's medal has been awarded to Mr. Douglas W. Freshfield for his explorations in the Caucasus and the Himalaya, and for his persistent efforts to further the spread and raise the standard of geographical education. In 1868 he made a journey to the central Caucasus which included the first ascents of Kasbek and the eastern summit of Elbruz and the discovery of new snow passes across

the main chain, besides yielding valuable information as to the topography and glaciation of the region. In 1887 and 1889 Mr. Freshfield undertook further journeys to the Caucasus, which added very largely to accurate knowledge of the central group, to the physical geography of the main chain, and to the correct delineation of the higher region, which previously had been but imperfectly mapped. A journey from the headwaters of the Ingur through Abkhasia to Sukhum Kaleh also deserves mention. The two volumes in which Mr. Freshfield has published an account of these travels, 'Central Caucasus and Bashan,' 1869, and 'Exploration of the Caucasus,' 1896, are standard works on the region with which they deal, and contain excellent maps, the fine map of the Caucasus, embodying much new work, being especially noteworthy. In 1899 Mr. Freshfield broke new ground, carrying out an expedition into Sikhim and Nepal, where he made the circuit of Kanchinjunga at a high level, one of the passes being of the height of 20,000 feet. This journey, though interfered with by an exceptional snowfall, yielded valuable results as regards the glaciation and the physical geography of the district.

The recipient of the other royal medal, which is bestowed annually by the patron, is Captain Otto Sverdrup, the leader of the admirably organized and conducted expedition in the *Fram*, extending over a period of four years, which has done so much to complete our knowledge of the geography of the Arctic regions. The expedition was the first to penetrate through Jones Sound to the Arctic seas beyond. It explored the western shores of Ellesmere Land, defining the main outlines of its intricate system of fiords and reaching from the south to a point within sixty miles of that reached by Aldrich on his journey round the north coast. To the west of Ellesmere Land three large islands were discovered, extending west to about 106° west longitude; this discovery confirmed the conjecture that land existed to the north of the Parry Islands. Of the Parry Islands the north shores of Findlay's Island and North Devon were explored for the first time. It will be remembered that Captain Sverdrup was captain of the *Fram* during Dr. Nansen's great expedition, and assumed command when Nansen left the ship. He safely worked the *Fram* clear from the ice, after attaining a latitude of 86° north.

The Victoria medal for geographical research had already been awarded as a special medal to Dr. Sven Hedin.

The minor awards of the society have been bestowed by the council as follows: (1) The Murchison grant is awarded to Mr. Isaachsen, a lieutenant in the Norwegian army, who accompanied Captain Sverdrup on his last expedition. He assisted with the astronomical and magnetic observations, and had charge of the cartographical work. He was Captain Sverdrup's right-hand man, and did a great amount of exploring work. He it was who discovered the two most westerly of the three islands the existence of which the expedition made known for the first time. (2) The Gill memorial goes to Mr. Ellsworth Huntington, an American traveler, who carried out a remarkable journey through the Great Cañon of the Euphrates River, during which he made valuable observations in physical geography. (3) The Back grant is bestowed on Dr. W. G. Smith, of Yorkshire College, Leeds, for his investigations into the geographical distribution of vegetation in Yorkshire, embodied in maps and a paper which will shortly be published. (4) The Peek grant is received by Major Burdon, whose name has been mentioned as the probable first resident at Sokoto, in the Northern Nigerian Protectorate. He has presented to the society a number of excellent route maps which he has compiled as the result of his journeys in northern Nigeria.

SCIENTIFIC NOTES AND NEWS.

The spring meeting of the council of the American Association for the Advancement of Science will be held in the Cosmos Club, Washington, D. C., on Thursday, April 23, 1903, at 4:30 P.M.

The annual stated session of the National Academy of Sciences begins at Washington on Tuesday, April 21.

THE Laboratory of the United States Fish Commission at Woods Hole, Mass., will be opened on June 15 for the nineteenth season of its existence. The privileges of the laboratory, including the services of the staff of collectors and use of the commission's fleet of vessels, are as usual extended free of charge to those competent to carry on research in marine biology. Applications for tables should be sent to the director of the laboratory, Dr. F. B. Sumner, 17 Lexington Ave., New York City.

MR. OTTO H. TITTMANN, superintendent of the U. S. Coast and Geodetic Survey, has been appointed commissioner for the United States to mark the boundary line between this country and Canada.

THE subject of the Silliman lectures to be given at Yale University by Professor J. J. Thomson, of Cambridge University, will be 'The Present Development of Our Ideas of Electricity.' The lectures, eight in number, will begin May 14.

THE Prince and Princess of Wales, will receive the honorary degrees of Doctor of Laws and Doctor of Music respectively from the University of London on Wednesday evening, June 24.

THE British Academy has elected new fellows increasing the membership from forty-eight to seventy. Among those elected were Professor F. Y. Edgeworth, professor of political economy, Oxford University; Professor B. Bosanquet, professor of moral philosophy, St. Andrew's University; and Dr. G. F. Stout, Wilde reader in mental philosophy, at Oxford University.

DR. FREDERICK C. NEWCOMBE, professor of botany at the University of Michigan, has been elected president of the Michigan Academy of Science.

PROFESSOR W. S. JACKMAN, of the University of Chicago, has been elected president of the Natonal Society for the Scientific Study of Education.

THE Hon. Andrew D. White, recently ambassador to Germany and formerly president of Cornell University, will return to the United States in June and will spend the summer at Ithaca.

DR. WALDEMAR KOCH, assistant in pharmacology, at the University of Chicago, leaves, at the end of the quarter, for six months' work in Schmiedeberg's laboratory in Strassburg. Dr. Koch will also visit the leading physiological and pharmacological laboratories in Europe, including Pawlow's in St. Petersburg.

DR. K. A. EWALD, professor of medicine in the University of Berlin, expects to visit the United States in May.

PROFESSOR H. L. BOLLEY, botanist of the North Dakota Agricultural College and Experiment Station has been appointed special agent for the investigation of the flax crop and flax diseases in Europe. Mr. Bolley will sail the first of June, spend some time in the Netherlands and then proceed to eastern Russia, where an extensive study will be made upon the Russian crop, with a view to procuring types of seed which will be valuable for use in this country. Professor Bolley has lately made some very interesting discoveries concerning the cause of flax-sick soil. He seems to have shown that the reason flax can not be grown continuously on the same ground is due to the presence of a wilt disease caused by a species of Fusarium.

MR. ELLSWORTH HUNTINGTON has lately been appointed research assistant by the Carnegie Institution and will go with Professor Davis to join Professor Pumpelly in Turkestan. Mr. Huntington graduated at Beloit College, Wisconsin, in 1897; he then spent four years as science teacher in Euphrates College, Harput, Turkey, and while there made an adventurous journey through the cañons of the Euphrates, for which he has lately received the Gill memorial from the Royal Geographical Society of London. For the past two years he has been attending the Graduate School of Harvard University, and last summer he was one of Professor Davis's party in Utah and Arizona.

DR. HERBERT S. JENNINGS, assistant professor of zoology at the University of Mich-

igan, has been awarded a grant of $250 by Carnegie Institution.

Mr. Albert P. Morse, curator of the Zoological Museum of Wellesley College, has been appointed a research assistant in the Carnegie Institution. Mr. Morse will undertake a systematic and biological study of the North American *Acrididæ* with especial reference to geographical distribution, dispersal and variation; and will probably spend July and August in field work in the southeastern states.

The New York *Times* states that the administrative board appointed to organize and conduct the international congresses to be held in connection with the World's Fair in St. Louis in 1904, met on March 11 at the eastern offices of the exhibition. There were present President Butler, of Columbia University, chairman; President Harper, University of Chicago; President Jesse, University of Missouri; Dr. Herbert Putnam, Librarian of Congress, and Frederick W. Holls, member of The Hague Tribunal. The board met to consider the report of the committee on the Congress of Arts and Science, which had been in session the two preceding days. The members of the committee met with the board. They are: Professor Simon Newcomb, Washington; Professor Hugo Münsterberg, Harvard University, and Professor Albion W. Small, University of Chicago. Mr. Howard J. Rogers, director of congresses, was also present. There is to be a 'Congress of Arts and Science,' with 128 sections. The board adjourned to meet in St. Louis on April 29.

The Swedish government has appropriated $20,000 for the publication of the scientific results of Dr. Sven Hedin's journey through central Asia. The work will comprise an atlas of two large volumes, while a third volume will contain Dr. Hedin's report on the geography of the country. Further volumes will be devoted to the meteorological observations, the astronomical observations, the geological, botanical and zoological collections, and the Chinese manuscripts and inscriptions. The work will be published in the English language.

Dr. William T. Harris, U. S. Commissioner of Education, will deliver an address on April 25 at the School of Pedagogy, New York University, on 'Education in the United States.' The meeting has been arranged as a memorial to Dean Edward R. Shaw, and a portrait of Dr. Shaw will be presented by the students to the university.

Professor Henry Barker Hill, director of the Chemical Laboratory of Harvard College, died on April 6 in his fifty-fourth year.

Rear-Admiral George E. Belknap, retired, who in addition to eminent services in the navy was in charge of important hydrographic work and was at one time superintendent of the Naval Observatory, died on April 7, at the age of seventy-one years.

Dr. Laborde, an eminent French physician and a member of the Academy of Medicine, died on April 7.

The death is announced of Professor J. G. Wiborgh, of the Stockholm School of Mines, at the age of sixty-four. He was the leading authority on the metallurgy of iron in Sweden and the author of numerous works on the subject.

The daily papers state that the headquarters of the Carnegie Institution, Washington, are about to be removed from the private house at the corner of K and Fifteenth Streets, to a suite of offices in the Bond Building, at the corner of New York Avenue and Fourteenth Street.

A conference to consider the founding of a national seismic association will be held at Strasburg at the end of July.

Four thousand Spanish physicians and fifteen hundred foreigners have already registered for the International Congress of Medicine to be held at Madrid at the end of the present month.

We learn from *Nature* that the officials of the Sanitary Deparment of the Egyptian Government, into whose hands the expenditure of the recent gift of 40,000*l.* entrusted to Lord Cromer and his successors in office by Sir Ernest Cassel for the relief of ophthalmia and eye diseases has virtually passed, have decided

to employ it in establishing a 'traveling dispensary' in the form of a tent, to suffice for all purposes of operation and treatment, and to work solely in the provinces.

THE annual meeting of the general board of the National Physical Laboratory of Great Britain was held on March 20, Lord Rayleigh, the chairman of the board, presiding. According to a notice in the London *Times* the annual report of the executive committee, giving details of the work since the opening of the laboratory, was approved. It appears from the report that subscriptions and donations amounting to nearly £1,000 a year have been promised by the Institution of Civil Engineers, the Iron and Steel Institute, the Institute of Chemical Industry, and various private firms. Efforts are being made to extend the list and more especially to render the laboratory self-supporting by increasing the work done for firms and private individuals. Examples of such work are given in the report and in a lecture to the Students' Association of Mechanical Engineers recently delivered at the Institution of Mechanical Engineers by the director and now being published in *Engineering*. The scheme of work suggested by the director for 1903 was also approved. After the meeting an inspection of the laboratory took place, and in this the board were accompanied by a number of gentlemen who have assisted the laboratory by serving on its various committees, or as donors of apparatus.

CABLEGRAMS are no longer sent giving reports of the plague in India, and the subject has been practically forgotten by the general public. For the last week, however, for which reports are at hand, the deaths numbered 28,860, much more than at any corresponding period of the year since the original outbreak of the plague in 1896.

THE 'Annual Report of the Field Operations of the Bureau of Soils' for 1902, containing the results of the soil survey work of the bureau for the calendar year, has just been completed and is now in press. It will not, however, be available for distribution before October next, owing to the length of time necessary to lithograph the accompanying maps. It will be issued in two parts, one containing 44 lithograph soil maps drawn on a scale of one mile to the inch, covering each of the areas surveyed, indicating in colors the location and extent of the various soil types, and in addition, in western areas, the presence and amount of alkali existing. The other part, embracing about 800 pages, illustrated, contains the reports of assistants in charge of surveys. These reports treat each area in detail, and contain valuable data relating to the location and boundaries of the areas, history of settlement and agricultural development, climatic conditions, physiography and geology, descriptions of soil types with origin and process of formation, crops grown and yields, crops to which soils are especially adapted, special soil problems, irrigation and drainage, alkali conditions, agricultural methods in use, cultivation, cropping, and general agricultural and economic conditions. Fifteen soil parties were maintained in the field during the year, and there was surveyed and mapped 17,911 square miles, or 11,463,040 acres, covering thirty-two areas in twenty-five states and territories and in Porto Rico. The area previously surveyed by the bureau was 15,871 square miles, making a total to date of 33,782 square miles, or 21,620,480 acres. The total cost of the work, including transportation, salaries, subsistence, supplies, inspection, preparation of reports, etc., amounts to an average of $2.88 per square mile, or about thirty-three cents per one hundred acres. During the current year the number of soil survey parties has been increased to twenty, which it is expected will make surveys of about fifty areas in thirty-two states and territories.

THE London *Times* states that a new association to be called the Ulster Fisheries and Biology Association has been formed in Ireland. The object of the new association is to investigate the flora and fauna of the shores and fresh water loughs of Ulster, with special reference to the fisheries. At a meeting held at the museum, Lord Shaftesbury, who presided, said the association had in view

the organizing and equipment of a marine laboratory for the purpose of carrying out investigations and researches. It was hoped that the work of the new organization would assist to develop the fishing industry. He was glad to say that the Department of Agriculture and Technical Instruction had been approached and had decided to help them. That, he thought, was sufficient to indicate that the new association had useful work before it. Mr. H. H. Smiley, who has subscribed £200 towards the funds of the association, was elected first president. It is proposed to start operations at Larne Harbor, where there will be a small marine laboratory. A naturalist has been appointed, who will furnish reports from time to time in the physical and chemical characteristics of the sea water and make other observations.

Recently the President asked the Commissioner of Fish and Fisheries to have made a comprehensive and thorough investigation of the salmon fisheries of Alaska, and for this purpose Commissioner Bowers has appointed a special Alaska Salmon Commission consisting of the following: President David Starr Jordan, of Stanford University, executive head; Dr. Barton Warren Evermann, ichthyologist of the U. S. Fish Commission; Lieutenant Franklin Swift, U. S. N., commanding officer of the *Albatross;* Cloudsley Rutter, naturalist of the *Albatross;* A. B. Alexander, fishery expert of the *Albatross;* and J. Nelson Wisner, superintendent of fish cultural stations of the U. S. Fish Commission. The steamer *Albatross* has been detailed to this work and will go north early in June. The Alaska salmon fisheries are of very great importance, the output of the canneries last year amounting to 2,631,230 cases (of 48 pounds each) valued at $8,667,673. To secure this pack more than 36,000,000 salmon were utilized. It is doubtful if the waters of Alaska can long withstand such an enormous drain as this, and it is for the purpose of securing information upon such questions as this that the investigations will be made.

The Baltimore *Sun* gives details of the expedition to be sent by the Geographical Society of Baltimore to the Bahama Islands, according to which the staff will number fifty persons, and will leave Baltimore early in June in a specially chartered vessel, fully equipped to serve as the home and laboratory of the party during its absence on the trip. The scientific staff will be divided into departments for the study of insular geology, botany, zoology, medical and hygienic conditions, climatology, physics, commercial geography and history. Dr. George B. Shattuck, who was asked by the directors of the society to organize the expedition, will have charge of the geological work. He will have three assistants. Dr. W. C. Coker, professor of biology in the University of North Carolina, will direct the work in botany. Dr. Barton Blow, curator of fish in the National Museum, will investigate the fish of the seas around the islands. Mr. O. C. Glaser, of the Hopkins department of biology, will study the mollusks and Mr. R. P. Cowles, fellow in biology, the cardita of the island. Dr. O. L. Fassig, of the Baltimore office of the United States Weather Bureau, will superintend the work in climatology. A person not yet named will direct the survey of the commercial possibilities of the islands. Mr. J. M. Wright of the Hopkins historical department will have access to the records of the islands, and will prepare a monographic history of them. Mr. A. H. Baldwin, a Washington artist, will be the official illustrator. To Dr. C. A. Penrose will be given the position of director of the medical staff. This department will look into the sanitary conditions of the islands and will notice the effect of the climate on Americans.

The British Medical Journal summarizes the vital statistics for the year 1902 of the seventy-six large towns dealt with in the Registrar-General's weekly returns. The 452,909 births registered in these towns during last year were equal to an annual rate of 30.0 per 1,000 of their aggregate population, estimated at 14,862,880 persons in the middle of the year. In London the birth-rate was equal to 28.5 per 1,000, while it averaged 31.1 per 1,000 in the seventy-five large provincial towns. The lowest birth-rates in these towns

were 17.1 in Bournemouth, 18.2 in Hastings, 20.8 in Hornsey and in Bury, 21.3 in Halifax, 23.0 in Bradford, and 24.0 in Rochdale; the highest rates were 36.4 in East Ham, 36.5 in South Shields, 36.7 in Gateshead, 37.5 in St. Helens, 37.9 in Wigan, 39.4 in Merthyr Tydfil, and 41.5 in Rhondda. During the period under notice 263,091 deaths were registered in these seventy-six towns, corresponding to an annual rate of 17.4 per 1,000 living. In London the rate of mortality was 17.7 per 1,000, while it averaged 17.6 in the seventy-five other large towns, among which the rates ranged from 8.6 in Hornsey, 10.9 in Hansworth, 11.5 in Walthamstow, 11.6 in King's Norton, 11.9 in East Ham and in Leyton, and 12.4 in Bournemouth to 20.0 in Hanley, in St. Helens and in Manchester, 20.2 in Middlesbrough, 20.6 in Wigan, 22.5 in Liverpool, and 23.1 in Merthyr Tydfil. The 263,091 deaths from all causes registered in these seventy-six towns last year included 32,021 which were referred to the principal infectious diseases; of these, 1,764 resulted from small-pox, 7,441 from measles, 2,870 from scarlet fever, 3,924 from diphtheria, 5,578 from whooping-cough, 2,336 from 'fever' (principally enteric), and 8,108 from diarrhea. The death-rate from these diseases averaged 2.12 per 1,000 in the seventy-six large towns.

THE efforts of the hydrographic branch of the United States Geological Survey are being directed to the discovery of sufficient water to lead to the reclamation and habitation of that area of the Great Plains lying west of the prairies and east of the Rocky Mountains, commonly known as the High Plains. The section is admirably suited to agriculture and grazing except for its inadequate water supply, which is so uncertain that great areas of fertile land lie quite uninhabited. This is especially true of the regions lying between the river valleys which cross it at wide intervals. These broad intervalley plateaus are practically waterless, but it has been discovered that water may be had from underground sources by wells and windmills, and it has been demonstrated that, while the region may not be largely reclaimable by irrigation, it may be successfully used for grazing by creating stock-watering points at comparatively close intervals. It will, however, be difficult, if not impossible, for the grazers to raise anything besides fodder cane of the drought-resisting varieties, such as Kaffir corn. Vegetables and other products will, for the most part, probably have to be grown elsewhere. The river valleys, on the other hand, seem destined to be extensively cultivated by irrigation, the water for which will be pumped from the gravels of the river beds, where an underflow has been known to continue in the summer season after the rivers themselves have ceased to run. These areas will furnish garden produce for the ranches on the plateau, and in this manner make the region as a whole habitable. The details of this investigation, with exhaustive studies of the nature of the underground waters of the High Plains, appear in the Twenty-first and Twenty-second Annual Reports of the United States Geological Survey, the latter of which is now in press and will soon be issued.

UNIVERSITY AND EDUCATIONAL NEWS.

ON April 1 Governor Peabody signed a bill giving to the University of Colorado two fifths of a mill annually on the taxable property of the state. This assures an income for the present of $140,000 per annum, with an automatic increase depending on the growth in wealth of the state. The university has now enrolled about 550 students.

MR. ANDREW CARNEGIE has offered to pay the expenses of the students of Cornell University, who suffered from typhoid fever during the recent epidemic at Ithaca.

MRS. VAIL, wife of Professor Vail, has given Hobart College $5,000 to establish a fund to be known as the Charles Delamater Vail library fund.

THREE scholarships of $200, $150 and $125 are announced for the Harvard summer geological course in Colorado under Mr. C. H. White. These scholarships are open to general application from teachers and students of geology, whether now enrolled at Harvard University or not. Applications should be addressed to Mr. White, at the Rotch Build-

ing, Cambridge, Mass., and should state the applicant's previous training in geology and his purpose in further study. Letters of recommendation should be enclosed. Action on applications will be taken about June 1. The expenses of the course, including fee for instruction, will be about $200 from Chicago and return.

The class in geology and mining of the Missouri School of Mines and Metallurgy will make a summer excursion this year, in charge of Director George E. Ladd, to the Black Hills, Butte and Anaconda and the Yellowstone Park. Similar excursions will in the future be a required part of the work at this institution. The new catalogue of this school announces that there will be made, during the spring and summer months, as a part of regular courses, excursions to the Joplin mining district for mine surveying; to the Gasconad River for field practice in lines of communication; to southeast Missouri for geological field work; and to Joplin, St. Louis, Herculaneum and the Flat River district for the study of mines and ore-dressing and metallurgical plants.

The report prepared by the business committee of the general council of the University of Glasgow in response to a statement drawn up at the request of the Carnegie trustees by the University Court and setting forth what in the opinion of the court were considered to be the most urgent needs of the university, the trustees have made to the university a grant of £55,000, the payment being distributed over a period of five years. This includes an annual grant for the period above named of £8,000 for buildings and permanent equipment, the branches of study which are to benefit including natural philosophy, materia medica, physiology, forensic medicine and, if any sum remains over, chemistry or geology. There is also to be for five years an annual grant of £2,000 for teaching, including the endowment of a chair of geology, for which the capital sum is £7,500. The annual grant to the library for the same period is to be £1,000. The University Court has now allotted sites for new buildings for the department of natural philosophy and for the department of materia medica, physiology and forensic medicine and public health, and progress with these buildings may be expected without delay.

At the University of Pennsylvania senior fellowships of the value of $800 for those who have already taken their doctor's degree have been awarded. In zoology, to Dana B. Casteel, of Tarentum, Pa., A.B. (Allegheny College, 1899), A.M. (Ohio Wesleyan, 1900); in mathematics, to Lewis I. Neikirk, of Boulder, Col., A.B., M.S. (University of Colorado, 1898, 1901). Ordinary fellowships of the value of $500 have been awarded. In psychology, to Robert H. Gault, of Ellsworth Station, O., A.B. (Cornell, 1902); in biology, to Everett F. Phillips, of Youngstown, O., A.B. (Allegheny College, 1899). The Tyndall fellowship in physics was granted to Leon W. Hartman, of Walton, N. Y., B.S., A.M. (Cornell, 1898, 1899). A special fellowship in mathematics for the year 1903–04 was given to Professor B. F. Finkel, of Drury College, Springfield, Mo. Fellowships for women were awarded as follows; Bennett fellowship in mathematics, to Alice M. McKelden, A.B., A.M. (Columbian, 1899; University of Pennsylvania, 1900). Bennett fellowship in chemistry, to Alice L. Davidson, A.B. (Elmira College, 1902). Moore fellowship in zoology, to Annie B. Sargent, Bellwood, Pa., B.S. in biology (Pennsylvania, 1899).

The formal installation of the newly elected president of Hobart College, the Rev. Langdon Cheves Stewardson, will take place on commencement day, June 17.

The departments of mining engineering and metallurgy at McGill University will be separated. Professor Stansfield will have charge of the metallurgical department, while Professor Porter will continue to direct that of mining engineering.

Dr. Joseph Barrell, assistant professor of geology at Lehigh University, has received a call to a similar position at Yale University.

Benjamin L. Miller, A.B. (Kansas), Ph.D. (Johns Hopkins), has been appointed associate in geology in Bryn Mawr College.